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DARKROOM design and construction

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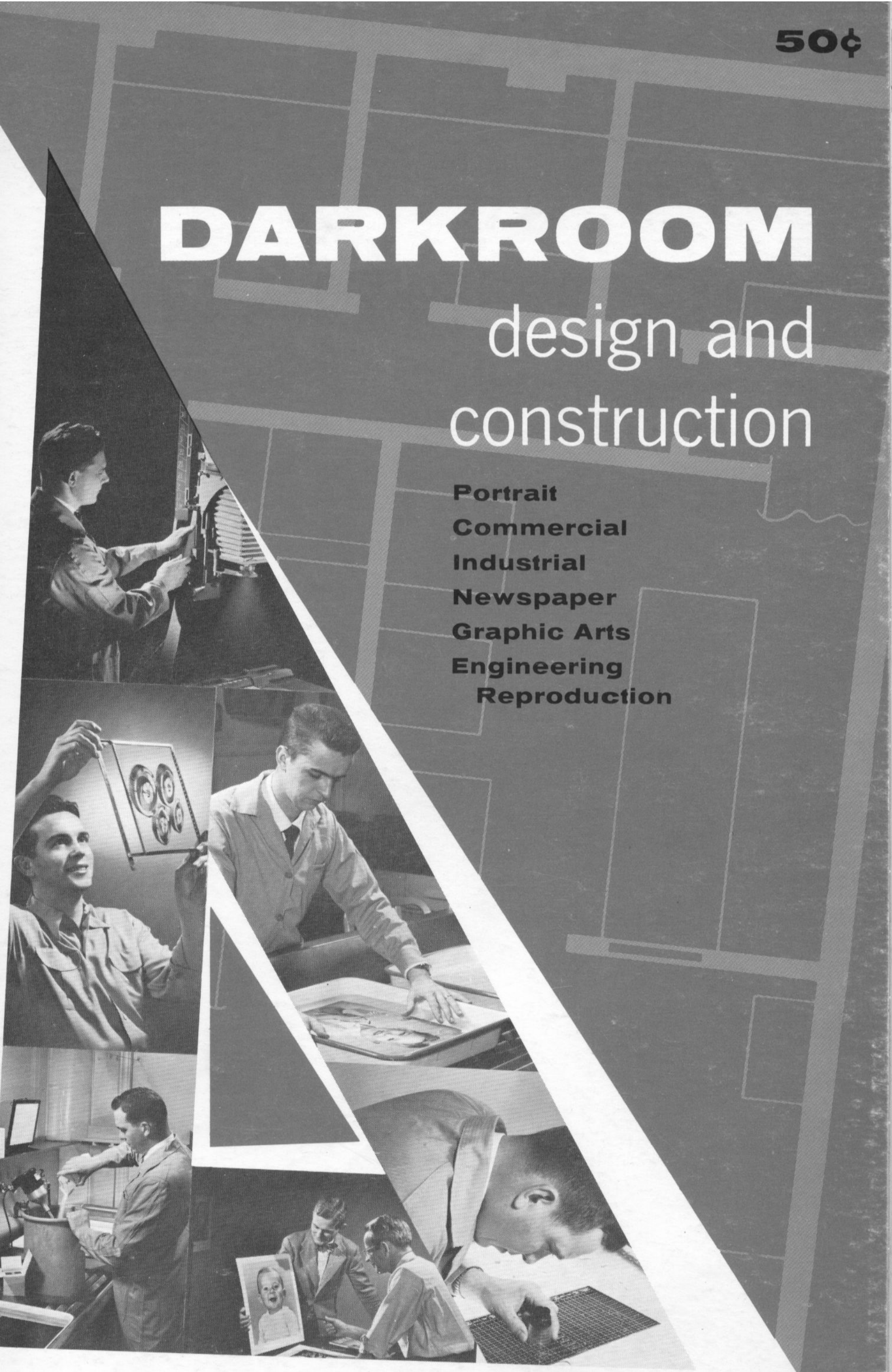

SECOND EDITION

FIRST 1958 PRINTING

The Kodak Data Book
Darkroom Design and Construction
is a complete revision of the First Edition entitled Darkroom Construction for Professional, Photomechanical, and Industrial Use.

It is intended for use by people engaged in portrait, commercial, in- lustrial, graphic arts, engineering reproduction, and newspaper pho- ography. Subjects discussed include preliminary planning, entrances, vall and floor covering, electric wiring, ventilation, plumbing, and ench construction. Also included in this book are a number of layouts vhich were originally prepared to meet specific requirements of space, rea shape, available equipment, and type of work to be done.

This is not a do-it-yourself publication. Rather, it is intended as a guide to be consulted before talking to an architect or builder.

Darkroom Design and Construction is one of a whole series of Data Books published by Kodak on black-and-white and color photography. Data Books are available at both the beginner and advanced levels. The scope embraces information on photographic techniques, processes, and naterials in the amateur, professional, industrial, scientific, and graphic rts fields. Each Data Book is a self-contained unit, punched for inser- tion in a metal-ring binder.

The Kodak Handbooks

Some of the Data Books, on particular subjects, have been bound in attractive, metal-ring, stiff-covered binders to form reference hand- books. Each handbook contains the basic Data Books relating to one specific field, tabbed separators for indexing, space for additional Data Books and free Kodak literature, and a registration card. Filling out and eturning the card contained in the *Kodak Reference Handbook, Vol- umes 1 and 2,* the *Kodak Color Handbook,* the *Kodak Professional Handbook,* the *Kodak Industrial Handbook,* and the *Kodak Photo- graphic Notebook* entitle you to receive an illustrated newsletter which is published several times a year. This free publication, besides describ- ing the latest Kodak techniques, materials, and processes, also an- nounces new and revised publications as they become available for sale by your Kodak dealer, so that you can keep your handbook up-to-date.

Darkroom Design and Construction

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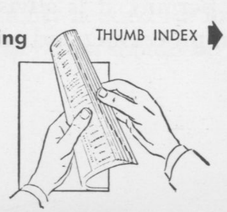
SECOND EDITION, 1958—First 1958 Printing

THUMB INDEX ➧



Entrances
Wall Covering
Floor Covering
Electric Wiring
Safelights
Ventilation
Plumbing
Processing Sinks
Water-Temperature Control
Dry Bench
Loading, Mixing, and Finishing Rooms
Typical Layouts

Darkroom Design and Construction

• The need for darkroom planning arises when a new studio or photographic laboratory is being contemplated or the existing facilities are going to be modernized, expanded, consolidated, or moved to another location. In each case, it is necessary to comply with local building codes and other safety regulations. For this reason, it is advisable to obtain the professional assistance of an architect or a builder who has architectural advice available.

Before consulting with the architect, however, the photographer can utilize his experience in his field to prepare a preliminary layout from which the architect can draw detailed construction plans. In planning the preliminary layout, the following factors should be considered:

1. The anticipated work output
2. The number of people who will be working in the space
3. The major pieces of equipment to be installed
4. The space available
5. The physical flow of work through the area

In estimating the volume of work to be done in the darkroom, allowances should be made for periods of peak production and the possibility of future increases in production load. Consideration should be given also to the possibility of future changes in the nature of the work, such as the addition of color processing. If these allowances are not made, the facilities may soon become inadequate, with numerous inconveniences and delays causing disruptions of the normal flow patterns of work. To correct such a situation, workrooms may have to be enlarged at a future date, resulting in extra construction costs, interruptions in production, and probable sacrifice of necessary space in adjoining rooms. If the rooms are planned with forethought, equipment and personnel to handle increased volume can be added later with little difficulty.

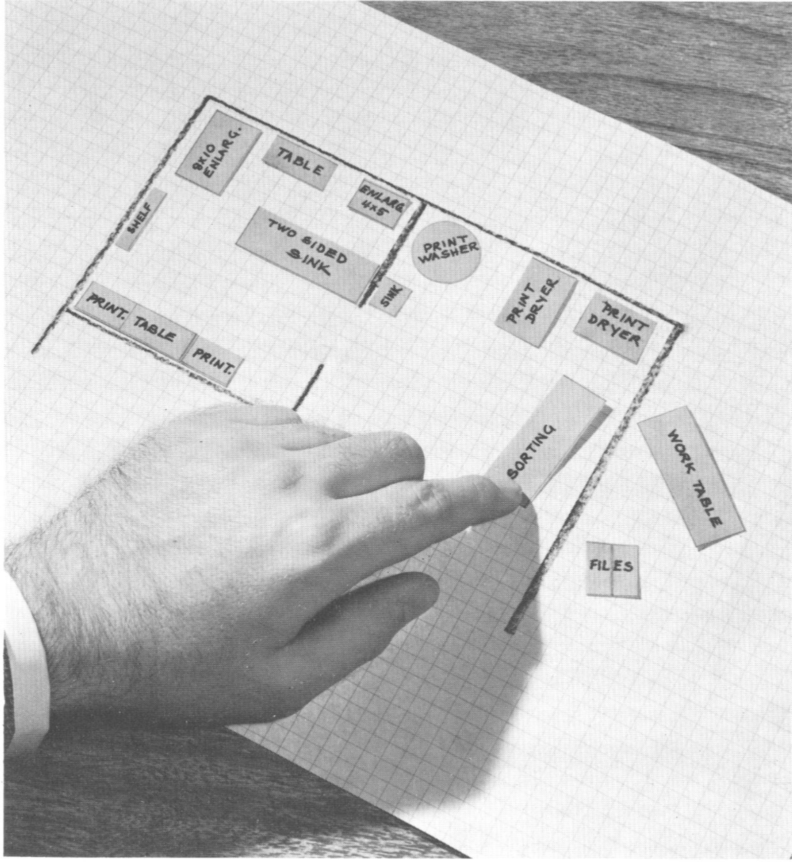
If space permits, it is advisable to have at least two darkrooms—one for film processing and one for printing operations. If more than two persons will use the film darkroom to any great extent, two such rooms should be provided. A special darkroom for processing color films should be considered if a sizable quantity of such work is planned. A small room for loading film holders helps to reduce the darkroom traffic and keep unused films apart from those ready to be developed.

Since the essential characteristic of any good darkroom layout is usability, the necessary equipment and materials should be arranged to allow the work to progress in the most efficient and convenient manner, with a minimum of lost motion. The operations should move smoothly from the loading and unloading of the film holders to the wrapping of the finished prints. The shorter and smoother this pattern is, the more efficient is the operation of the establishment. In fact, providing for an efficient flow of work with the greatest economy of time and effort is really the most important factor in darkroom design, but it is often overlooked or improperly handled.

The darkroom should be separated into "wet" and "dry" areas. The wet area includes the sinks, and all processing operations and solution handling are done here. The dry area includes the workbenches where sensitized materials are stored and handled and where enlargers and printers are located. This separation of the work areas guards against splashing of the sensitized materials with liquids used in processing. Ideally, sinks and dry benches should be located on opposite sides of the darkroom, with an aisle between. However, any distance between them that is greater than about 3 feet for one occupant or 4 feet for two is unnecessary and tiring.

The necessary trays or tanks can be arranged along a wall, in a corner, or down the middle of a room. Usually, the best arrangement is a straight line of trays or tanks along a wall. The same water and drain lines can be utilized by placing sinks side-by-side along a wall or, if desired, back-to-back in the middle of the room. However, economizing on the plumbing bill should not be done at the expense of the over-all efficiency of the workrooms.

Entrances should generally be at the end of an aisle, because a door placed in the middle area of a side wall is wasteful of space and reduces the length of a bench or sink. In general, the sink and bench can be the same length, but if there is need for shortening one or the other a little, the following points should be kept in mind: In a film darkroom, the sink should be longer than the bench because tanks and trays take up more room than is usually needed for loading and unloading films. In a printing room, the dry area should be the longer

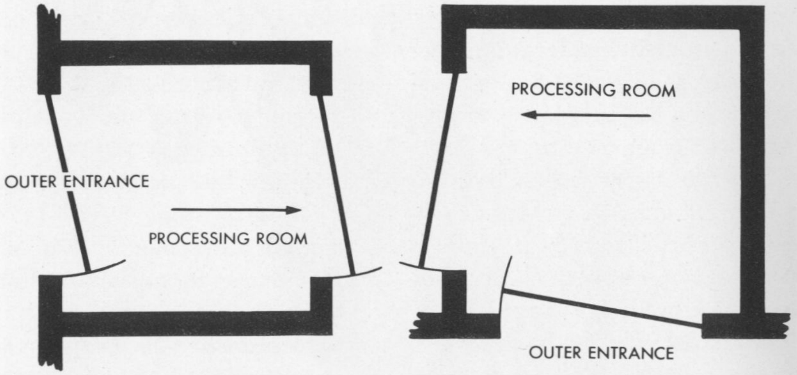

8X10 ENLARG.
TABLE
ENLARG. 4X5
SHELF
TWO SIDED SINK
PRINT WASHER
SINK
PRINT DRYER
PRINT DRYER
PRINT. TABLE
PRINT.
SORTING
WORK TABLE
FILES

Entrances

• The type of entrance best suited to a particular installation is determined largely by the number of people using the darkroom, the amount of floor space that may be available, and the size of the photographic materials used.

The Single Door. If only one or two persons utilize the darkroom routinely, a single lighttight door equipped with an inside bolt or lock will suffice. The economy of floor space permitted by this arrangement more than offsets any slight inconvenience that may arise from locking the door. Whenever a single locked door is used, provisions must be made for unlocking it quickly from the outside in the event of emergencies.

The Light Lock. This type of entrance may consist of a small hall with two doors, one of which opens into the darkroom and the other to the outside. These doors may be either opposite or adjacent to each other. Interlocking devices, either electrical or mechanical, can be installed to prevent the accidental opening of both doors at the same time. However, safety releases must be incorporated in the interlock so that it is possible to open both doors to move supplies into the darkroom or in case of emergency. If interlocks are not provided, it is a good plan to install a warning light or buzzer which will operate when either door is open, thus reducing the possibility of both doors being opened at once.



A light lock requires two doors with a minimum width of 2½ feet each. These doors can be opposite or adjacent and should have warning lights or buzzers installed to protect against accidental opening of the doors. There are now available electric interlock devices which, when a darkroom door is opened, automatically bolt the other doors in the light lock.

To relieve changes in air pressure caused by opening and closing the doors and to provide some ventilation, a lightproof vent should be installed in either a door or wall of the light lock. All of these arrangements can be employed with either hinged or sliding doors, or one or both of the doors can be replaced by heavy single or double curtains.

The walls may be any desired color because the safety of the light lock does not depend upon absorption of light, as is the situation in a labyrinth. A flat finish is not necessary; in fact, a glossy wall tile or enamel is preferable because it makes cleaning easier.

The light lock can be illuminated by a Kodak Darkroom Lamp or 2-Way Safelamp fitted with the appropriate Kodak Safelight Filter.

Minimum dimensions for a light lock depend on the size of the doors. The smallest door that should be used is 2½ feet by 7 feet. The light lock must be large enough to enable a person going through to open or close either door from within while the other is closed.

The Labyrinth. The labyrinth, or "maze," as it is often called, provides the advantages of not having doors. It protects against white light and allows free circulation of air in the processing room. Its chief disadvantage lies in the fact that it requires at least twice as much floor space as a light lock.

In constructing a labyrinth to conform to the needs of an individual darkroom, it is important to apply the principles of light reflection and absorption. By so doing, all possible invasion of white light into the darkroom can be studied so that a labyrinth of correct length and width can be designed and the necessary light baffles properly located. A carefully planned layout minimizes waste of floor space.

The application of the principles of light reflection to the general design of a labyrinth is shown in Figure 1. Since the efficiency of the labyrinth is affected by the light-absorbing properties of the surface finish, it is assumed that the wall and ceiling are painted flat black, which provides the greatest absorption.

To aid in illustrating the behavior of light, a window is located near the outer opening of the labyrinth shown in Figure 1. (Actually, it is poor practice to have a window, a bright wall, or strong room illumination in the immediate vicinity of the outside entrance.) White light from the window may shine through the entrance into the labyrinth (1) and onto the end wall(2). Since the wall surface at this point is flat black, about 92 percent of the light is absorbed. The angle of reflection of the beam of light is equal to the angle of incidence; therefore, the white light remaining (approximately 8 per-

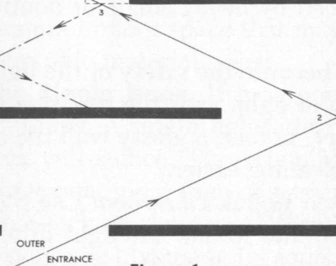
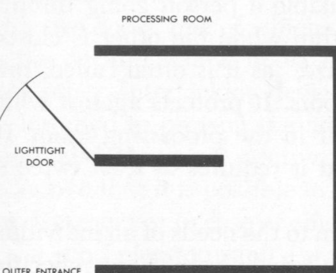

3
2
OUTER
ENTRANCE

Figure 1


PROCESSING ROOM
LIGHTTIGHT
DOOR
OUTER ENTRANCE

Wall Covering

- The darkroom ceiling, walls, and woodwork that are never in contact with chemical solutions require no special protection. A semigloss finish is satisfactory for the ceiling and walls, and a good, washable paint that provides a hard surface is suitable for all wood trim.

For wall surfaces that must be safeguarded against the action of processing solutions, the chemical resistance of the material is the primary consideration. Differentiation must be made between corrosion and stain resistance. Manufacturers of certain protective coating materials describe their products as being resistant to acids and alkalies. This may be true as far as corrosion is concerned, yet the surface may stain badly. For instance, a panel coated with a certain paint will not be corroded when immersed in a developer for twelve hours, yet a drop of the solution left on the panel until completely evaporated may either bleach the pigment or change the color, usually to a deep brown. This stain reaction also occurs in much the same manner on some types of sheet plastic.

Three methods may be employed for finishing the darkroom: (1) coating the entire room with a chemical-resistant material; (2) using a nonresistant coating on the "dry" side of the room and a corrosion- and stain-resistant material on the "wet" side; or (3) finishing the entire room with a nonresistant material and applying an additional covering of a resistant material on the "wet" side only.

The following materials are suitable for darkroom walls:

Paints, Varnishes, and Lacquers. There is available a small group of liquid protective materials that may be sprayed or brushed on the walls. They must, however, be applied carefully because, if even small areas are not well covered, the protective qualities of the coating are nullified. This precaution must be observed also if clear varnish or lacquer is used over a nonresistant coating, because splashes from a processing solution might penetrate at a poorly covered spot and cause discoloration of the underlying material.

Fumes from some coating materials, particularly clear varnishes and lacquers, will fog photographic films; therefore, whenever the processing room is to be refinished, all unprocessed film should be removed until the surfaces have dried.

Structural Glass. If applied in tightly joined panels, structural glass is one of the best materials for covering the walls. These opaque panels are available in a variety of colors and are easily cleaned. The danger of cracking or chipping is minimized if a structural glass that has been tempered during its manufacture is selected.

Ceramic Tile. In many instances, ceramic tile is used as a wall covering not only around the sink but throughout the room as well. A room whose walls are completely lined with tile, or even covered to a height of 5 or 6 feet, is extremely easy to keep clean. Wall tiles may be obtained in a wide variety of colors, in finishes ranging from a shiny to a matte glaze, and in plain, textured, polychrome, mottled, stippled, or rippled surfaces. A satin-finish or semigloss surface is less likely to absorb chemicals and become stained.

Plastics. Thin sheets of plastic may be used for covering the walls in the vicinity of the sink. There are a number of plastics completely resistant to staining and corrosion by processing solutions and suitable in color for this purpose.

REFLECTIVITY AND COLOR

It is no longer thought necessary to paint darkrooms jet black. If the quality of the light from a safelight lamp is "safe," the light from it reflected by any surface is also "safe," regardless of the color of the surface. Nor does the reflected light gain in intensity over the direct- or incident-light beam. The finish should therefore reflect the maximum amount of safelight illumination.

In order to appear bright, the color must reflect rather than absorb light from the safelight lamp. For example, the light transmitted by a Kodak Safelight Filter, Wratten Series 0A, is in the yellow and yellow-green portions of the spectrum. Therefore, maximum reflection under safelight illumination is achieved if the wall finish is either a color within this same spectral range or a light enough shade of any other color. From the aesthetic standpoint, it is obviously desirable to have a color that is pleasing under white light, as well as safelight illumination. The ceiling may be painted white to provide maximum reflection of ceiling light. For the side walls, warm tones, such as ivory, cream, buff, or extremely pale shades of any desired color are generally more pleasing than white, which is apt to be too glaring and shows soil quickly.

The visual changes in brightness values of colors when viewed under the safelight can be more readily understood if a color card, obtainable from a dealer in paint supplies, is studied under both white and safelight illumination. In this manner, a color can be selected that appeals to the eye under white light and provides satisfactory reflection of safelight illumination.

Floor Covering

• The choice of floor covering in a photographic darkroom presents several unusual problems. The ideal floor should have these qualities: resistance to corrosive substances, resistance to staining, watertight installation, durability, freedom from slipperiness, resiliency for foot comfort, and a suitable color. It is impossible to obtain all of these qualities in one material, but a compromise can be achieved by selecting a floor that combines the most essential properties. An ordinary wooden floor is relatively unsatisfactory because it is not watertight, and dust and chemicals will accumulate in the cracks.

The two most serious effects on floor coverings are corrosion and staining caused by contact with photographic chemicals. The degree of staining and corrosion is dependent on the chemically reactive properties of the pigment of the covering material and the absorptive qualities of the floor material itself. For example, if a material is impervious, a solution may remain on the surface until oxidized, and the residue may then be wiped off with a damp cloth. If the floor-covering material is porous enough to permit absorption of the solution, the residue will be difficult to remove and discoloration will be almost certain to result. The coloring pigments in some floor-covering materials are chemically reactive with photographic chemicals. The most chemically resistant materials have a high proportion of asphalt in their composition, and these are the dark-colored tiles. In order to obtain light colors, such a small proportion of asphalt is used that the chemical resistance is lowered. Therefore, the darker-colored asphalt materials are usually preferable for darkroom floors.

Damage from water on the floor must be guarded against. The darkroom flooring installation should be made in such a way that it can be wet mopped quite often without the possibility of damaging any ceiling below. This means that, when composition tiles are used, both the adhesive material and the flooring material itself must be absolutely watertight. Likewise, concrete or ceramic floors must be constructed so as to prevent the development of water leaks which will damage adjacent walls or ceilings.

No attempt should be made to lay a waterproof floor over an existing floor unless the latter is in good condition. All boards of wooden floors should be solid and fastened securely in place. If the boards move under traffic, they will break up the waterproofing. Concrete floors must be smooth and should show no signs of disintegration. If possible, the floor should be equipped with a side curb and a drain with the floor sloping slightly toward the drain. Flushing and wet mopping will then be facilitated greatly, and any accidental overflow of the tanks or sinks will flow to this drain.

In every darkroom there is the chance of occasional spilling of water and processing solutions. This creates a potential hazard of slipping, and for this reason a highly polished or waxed floor should not be used. Concrete, terrazzo, and some types of ceramic tile can be made less slippery by the inclusion of a moderate percentage of small abrasive grains which will leave the floor with a slightly roughened surface, but will not change its resistance to wear.

When constructing any of the waterproof floors discussed here, it is general practice to lay a fabric membrane before the waterproof floor is laid. Since paper membranes crack easily, an open-mesh cotton fabric saturated with pitch is recommended.

The following types of floor coverings stand out as desirable:

Ceramic Tiles. Several forms of floor tile composed of clay, shale, or other ceramic ingredients are suitable for use in the processing room. Although the ingredients and color of these tiles are generally the same throughout the mass, some natural clay tiles have a definite surface color imparted by the manufacturing process. The ideal tile, of course, is impervious to stain, has a surface from which dirt can be wiped easily, and is not slippery when wet.

The degree of vitrification and the body density are important factors in the choice of a tile, because the lower the density and the degree of vitrification, the more absorbent the tile. A vitreous tile has a degree of body density that absorbs less than 3 percent of the moisture and does not permit any penetration into the face that cannot be removed easily. Semivitreous and nonvitreous tile are not satisfactory because of their greater absorptivity.

There are three general types of ceramic tile: porcelain, natural clay, and quarry. Both porcelain and natural clay are impervious, easily cleaned, and nonstaining. Available in several colors, they can be obtained either with or without a nonskid abrasive aggregate.

Both the porcelain and the natural clay tiles can be obtained in the paver and the ceramic-mosaic forms. The surface area of the former is 6 square inches or more, while the ceramic mosaic is smaller and may be obtained in squares, hexagonals, or oblongs.

Quarry tile, made principally from clay and shale, has an exceedingly dense body. However, it is quite slippery when wet and cannot be obtained with an abrasive surface. It is, therefore, not satisfactory.

Composition Tiles. These are of many types and some are quite inexpensive. They are made of plastic, hard rubber, asphalt, or synthetic resin and can be laid down over existing flooring, including wood. The asphalt tiles are usually the best for most installations because they are quite stain-resistant and have long-wearing properties. Hard-rubber and plastic tiles are usually satisfactory, but some types stain easily, so a certain amount of caution must be used in the selection of these materials. Synthetic-resin tiles are undesirable because they tend to absorb chemicals and therefore stain easily.

Tile Joints and Setting Beds. The joint material, or mortar, between tiles may be attacked and stained by processing solutions. For this reason, the joints should be as narrow as possible so as to minimize the exposed area. The Tile Industry Research Bureau has prepared recommendations for the proper cement mixture to be used in setting ceramic-tile floors of processing rooms. This information may be secured from local contractors. Color should not be used in the joint material or mortar, as its addition tends to weaken the bond.

The following materials, though sometimes used in the darkroom, have their disadvantages, as described below:

Terazzo. This material consists of cement with an aggregate of colored marble chips and is obtainable in a variety of decorative colors and designs. Usually finished with a highly polished surface, it is quite slippery when wet. This condition may be overcome to some extent, however, by the inclusion of an aggregate of nonskid material. Since marble is rather porous, it is liable to be stained by solutions spilled on it; therefore, they should be mopped up immediately.

Mastic. Mixtures of sand and asphalt have been used in many chemical laboratories. This black material (mastic) is applied either hot or cold and is unaffected by chemicals. Because it is relatively soft, weighty equipment is liable to sink into it. For this reason, heavy objects must stand upon piers or feet resting firmly on the base surface of the floor. The resiliency of mastic makes it quite comfortable to walk on. However, because it is an unattractive black, it may be considered unsuitable for use in darkrooms.

Linoleum. Although linoleum is perhaps the most comfortable of all flooring materials upon which to walk, it is unsuitable for the darkroom. Both developer and fixer solutions stain linoleum badly, and water and solutions spilled on it eventually soften its surface. The use of wax or clear varnish is only a temporary protective measure, and requires frequent renewal.

Electric Wiring

• The electric wiring and equipment in the darkroom must conform to the regulations of the National Board of Fire Underwriters in order to safeguard the worker and the plant. The recommendations given here must also be subject to the approval of municipal or state authorities. This applies not only to existing darkrooms but also to those in which new equipment is to be installed.

All electrical circuits should be designed for 30-ampere loads, and the number of these circuits should be determined by the total load of the electrical equipment which may be used eventually. Film and print driers, mounting presses, and copying lights all constitute large power drains which should be anticipated and provided for.

Electrical circuits should be provided with reset-type circuit breakers in preference to replaceable fuse links which may not be readily available when needed. If the control panel is located as close to the darkroom as possible, service can be restored quickly after an interruption, without the necessity of going to another part of the building to replace the fuse or reset the circuit breaker.

The lighting circuit should be separate from the equipment circuit in order to prevent safelights and room lights from being extinguished when equipment overloads interrupt the supply. The dangerous conditions encountered in a darkroom with respect to electric wiring are the proximity of wiring to the solution tanks and plumbing, spilled water on the floor, and moisture on the hands of the worker.

All exposed noncurrent-carrying metal parts of both fixed and portable equipment, such as the metal frame and exterior of each illuminator, safelight lamp, electric timer, and foot switch, must be grounded unless they are beyond normal reach of the worker.

If such equipment is correctly connected directly to the wiring system by means of an armored cable, a separate ground wire is not necessary, because the metallic sheathing is sufficient ground. Where allowed by electrical codes, receptacles for three-wire polarized plugs can be installed. No separate ground wire is needed with this system. However, if a two-wire cord is used, a separate ground connection must be installed. For ease of installation, the outlet box may be used with the third wire attached to both the metal part of the equipment and the box by means of suitable lugs, clamps, or other approved devices, but not by connections dependent upon solder. If a three-wire connection is not feasible, a length of No. 16 stranded fixture wire may be taped along the outside of the two-wire cord. The ground wire can be fastened to a cold-water pipe if the service outlet is difficult to reach.

As a safeguard, all outlets, switches, sockets, and the like should be composed of insulating materials. Chain pull-switches should have an insulating link or a section of cord in the chain.

Regardless of the degree of safety of the electric fixtures, the "one-hand rule" should be followed by keeping the other hand away from all objects when handling any electrical equipment or switches.

Foot switches eliminate the need for the use of hands in operating electric fixtures. However, the precautions which apply to the grounding of other fixtures are even more imperative when foot switches are installed, because the floor may be damp or even wet.

The placement and circuit wiring of the various outlets should be planned for the convenience of the worker. Convenience outlets should be located in the walls at waist level or higher and immediately behind the apparatus which they are to serve. This eliminates the hazard of trailing wires on the floor, and it also places the outlets far enough above the floor so that there is little danger of their being splashed accidentallly with spilled solutions or with water when the floor is mopped.

The darkroom lamp installed in the ceiling of the entrance light lock or labyrinth should have its switch at the side of the outer entrance so that the technician need not enter a darkened area. All processing-room circuits, white lights, safelight lamps, and outlets should be controlled by a master switch located above head height on or near the inside door frame. Below the master switch, another switch should be placed above shoulder level to control the white ceiling light* of the processing room. Both the master switch and the white-light switch are placed high so they will not be operated accidentally. It is also well to have a switch lock in the form of a flat plate placed on the white-light switch so that the white light cannot be turned on unless the plate is slid aside. Below these two switches, another switch is placed at waist level to control the safe-light lamps.

A red signal light should be located near the door outside the processing room. This should be controlled by the safelight-lamp switch so that, when it is on, the red light will glow and thus indicate that

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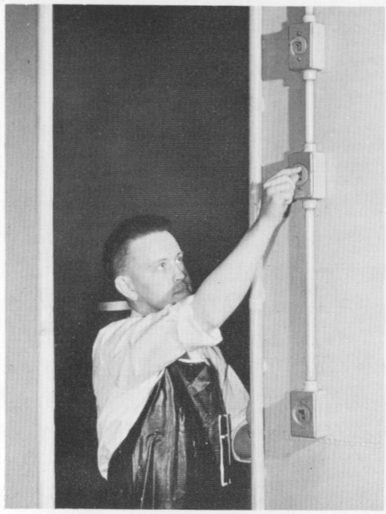
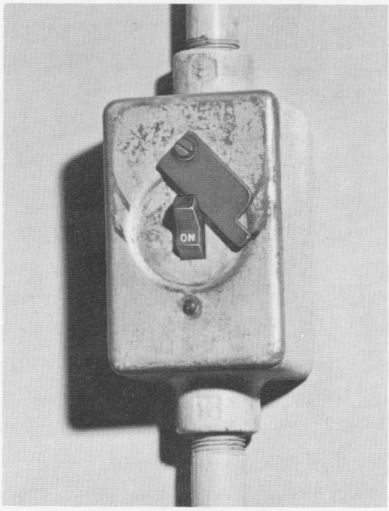
*It is recommended that the white lights in the darkroom be of the tungsten type. The afterglow from fluorescent lights has been known to fog film after the lights were turned out.



The master switch, controlling all darkroom circuits, should be placed above head height near the door. The white-light switch should be located below the master switch, and the safe-light switch should be below the other two at about waist level.



A flat plate serving as a switch lock will keep the white-light switch from being turned on accidentally. With the switch turned off, this plate can be turned counterclockwise to fit above it and hold it in the "off" position.

the darkroom is in use. This will prevent accidental opening of the door while films are being processed.

Safelights should be provided on the basis of one for each five linear feet of bench or sink working space. They should be located not less than four feet above the working level, and, at this distance, 15-watt bulbs should be used. All safelights should be wired on the same circuit, but they should also have individual switches to permit independent operation.

If the darkroom is adjacent to a studio, its electrical circuits should be separate from those of the studio so that changing equipment loads in the darkroom will have no effect on the output and color temperature of the studio lights. Conversely, this use of separate circuits will prevent varying studio lighting loads from affecting printing exposures and drying times.

Constant-voltage controllers for enlargers and printers will minimize the effects of random voltage fluctuations in black-and-white printing. If color printing is anticipated, voltage stabilization for each printer or enlarger is practically mandatory.

Safelights

• Darkrooms should have as high a degree of illumination as is consistent with the safety of the types of materials being processed. It is the function of a safelight to transmit a maximum of the visible light to which the material is the least sensitive. Safelights must be chosen carefully and used wisely. In this way, the total illumination level of the darkroom can often be sufficiently high for very comfortable vision. For example, a negative material such as Kodalith Ortho Film, Type 2, which is sensitive to only blue and green, can be handled in a relatively high level of red* light without danger of fogging. *Caution: Red Ruby bulbs should never be used, because, even though they look red, they often transmit light to which orthochromatic films and plates are sensitive.*

With panchromatic materials, which are sensitive to all colors of light, it is preferable to work in complete darkness where at all possible. If a safelight is used, it must be of the color to which the eye is most sensitive, namely, green. A dark-green safelight, such as the Kodak Safelight Filter, Wratten Series 3, is usable with most panchromatic materials if the printed precautions furnished with each package of sensitized material are observed.

POSITION OF SAFELIGHTS

The placement, as well as the size and type, of the safelight lamp will depend on the purpose which the light is to serve. The various units can be classed roughly as: general, to supply subdued illumination over the whole room without concentration at any one point; or local, to supply higher illumination on some particular point or object. The manner in which the two types are combined will depend on the size of the room and the type of work.

General illumination is normally used in only the printing or enlarging room, since negative materials, especially the fast panchromatic materials, should be handled in total darkness. Indirect lighting is best, and is easily obtained with a Kodak Utility Safelight Lamp, Model C, mounted to throw its light against the ceiling, which should be painted white or a light cream or green tint. The lamp should be fitted with the appropriate Kodak Safelight Filter.

Local illumination is needed, in addition to any general illumination, in order to provide sufficient light at certain strategic points.

*For this particular example, a Kodak Safelight Filter, Wratten Series 1A, is recommended.

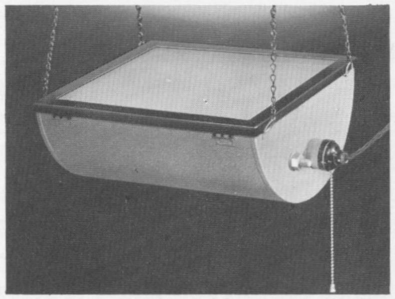
In the negative darkroom, the timer can be illuminated adequately, without danger of fogging the film, by mounting a Kodak 2-Way Safelamp so that its light is directed on the face of the timer. The position of the lamp should be such that the light is directed away from the developing tank or any point where film will be placed, and also such that the light will not be reflected in the eyes by the glass over the clock face. If there is more light than necessary, a mask cut from black paper can be used to reduce the luminous area of the safelight.

Another safelight can be placed over the bench where film is handled, but it should be turned on only when the light is really necessary. It is a great convenience to have a hand flashlight fitted with a circular Kodak Safelight Filter, Wratten Series 3, in place of the usual cover glass. It should be checked carefully for light leaks before it is used. Such a portable safelight is useful for hunting articles that have been dropped or misplaced, with little danger of causing fog on any film which might be exposed. It has also been found very convenient to use the little luminous buttons which are supplied for showing the position of electric switches in darkrooms or halls. These serve very nicely to locate the position of light switches, corners of sinks and benches, and other strategic points.

In the printing or enlarging darkroom, a great deal more light is permissible and desirable than in the negative room. Sufficient light

The Kodak Darkroom Lamp is a handy safelight lamp of many uses. It is particularly recommended for local illumination over the processing trays in a printing room.

The Kodak Utility Safelight Lamp, Model C, is ideal for illumination of large areas.



is needed particularly over the developing tray so that it will be possible to judge when the printing exposure and development are adjusted to give the best-quality prints. A safelight lamp can be mounted on the wall above the developing tray or suspended by a drop cord from the ceiling. In either case, it should be located not less than four feet above the working level and, at this distance, a 15-watt bulb should be used.

SAFELIGHT COLORS

It is usually necessary to have several safelights and safelight filters for the different classes of photographic materials being used. The correct uses of Kodak Safelight Filters are summarized below.

KODAK SAFELIGHT FILTERS

Wratten Series No.	*Color*	*For Use with:*
0A	Greenish Yellow	Contact printing and enlarging papers.
0C	Light Amber	High-speed enlarging papers, including Kodak Polycontrast Papers.
1	Red	Blue-sensitive films and plates, such as Kodak Commercial Film and Kodak Lantern Slide Plates; Kodagraph Projection Paper.
1A	Light Red	Kodalith materials and Kodagraph Contact Papers.
2	Dark Red	Orthochromatic films and plates, Kodagraph Fast Projection Paper, and green-sensitive film for photoradiography.
3	Dark Green	Panchromatic films and plates.
6B	Amber	X-ray film and blue-sensitive film for photoradiography.
7	Green	Infrared-sensitive films and plates and Kodak Ektacolor Print Film. Not safe for orthochromatic materials.
8	Dark Yellow	Eastman Color Print Film, Type 5382.
10	Dark Amber	Kodak Ektacolor Paper; Kodak Ektachrome Paper; Kodak Panalure Paper.

Kodak Safelight Filters have been prepared and tested specifically for exacting photographic use. Other materials may appear to have the same color as a tested safelight filter, but they may have a much greater photographic effect. The use of makeshift darkroom illumination is one of the surest ways of getting poor tone rendition.

Safelight lamps are so constructed that it is a simple matter to change the safelight filters to suit the material being handled. When the safelight filters are not in use, they can be stored in slotted racks located in a convenient position.

In the case of indirect-light boxes which are mounted near the ceiling for general illumination, however, it usually will be difficult to reach them to change the filters. In this case, it is desirable to have two safelights, each fitted with one of the two most commonly used safelight filters and controlled by a separate switch.

SAFETY OF SAFELIGHTS

Any photographic material will fog if left long enough under safelight illumination. This is not because the safelight transmits any light which it should not, but because even non-color-sensitive materials have some sensitivity to green, yellow, and red light. This sensitivity is not sufficient to be useful in picture-taking, but it is enough to cause fog or veiling with prolonged exposure under a safelight. All Kodak Safelight Filters, when used with the recommended bulb and at the recommended distance, are safe for at least 30 seconds with the dry materials for which they are recommended and for a longer time when the material is in the developer.

The harmful effects of improperly used safelights are noticeable in two types of results. The first can be seen as a definite fog that is produced in the unexposed areas of negatives or prints; the other, not so readily noticeable, is the degradation of image quality of paper prints caused by amounts of safelight exposures which are not in themselves sufficient to produce fog. The latter effect actually results from a double exposure—the first caused by the safelight, and the second caused by the printing of the paper print. If the safelight exposure was strong enough, its effect can be seen as fog in the borders of a print. However, even if the exposure was not long enough or intense enough to produce visible fog, the material may have been exposed sufficiently so that the image areas will develop to a higher density and cause a degradation of highlights and a loss of tone quality.

Unfortunately, the amount of fog a paper shows is not a measure of the amount of loss of quality it has suffered, because different kinds of paper show widely different quality changes for the same amount of fog. In particular, high-contrast papers used for line copy work from poor originals may show marked degradation of quality without production of fog.

TESTING SAFETY OF DARKROOM LIGHTING

Whenever a new darkroom is fitted up or any extensive changes are made in an existing room, it is a very wise precaution to check the safety of the illumination under the new conditions. This will determine whether the lighting is safe for the normal working conditions, and will show how great the safety factor actually is.

First, test for unsafe stray light leaking into the darkroom. Leave a partially covered strip of the film or paper in question on the bench or paper board for 15 minutes with all the safelights turned off. Develop the strip in a fresh developer for the normal time, rinse and fix it, and then examine it in a good light. If the portion which was covered appears lighter than the rest of the strip, unsafe stray light is leaking into the darkroom, and its source should be located and eliminated.

When the above test shows that the room is free from unsafe stray light, a simple but sensitive test of the safelights can be made as follows:

a. On a whole sheet of the film or paper in question, make a print from a typical negative, using the printing method commonly employed. Use a border mask to produce an unexposed area around the image. No safelight should be used during this part of the test.

b. Keeping one half of the sheet covered, expose portions of the other half to the safelight for 30 seconds, 1, 2, and 4 minutes. The test should be made where the material will be handled and developed and with the safelight located where it is commonly used.

c. Process the film or print in darkness and notice the amount of safelight exposure which can be given without noticeable change in quality of the image.

If this is less than about twice the time that the material would be handled in this position, the intensity of the light should be reduced by either using a bulb of lower wattage in the safelight lamp or moving the lamp to a greater distance from the working surface. After such an adjustment, the safelight illumination should be tested again.

In general, it will be found that an amount of safelight exposure which is not quite sufficient to produce fog in the border will show appreciable veiling of highlight areas in the print.

Safelights may deteriorate with age, particularly if exposed to excessive moisture or if overheated by a bulb of excessive wattage in the safelight lamp. This safelight test should therefore be repeated at intervals to make sure that the lighting remains safe.

NOTE: *Be sure that safelights are in good condition, i.e., not old, faded, or cracked; that they are used at the correct distance from the working area; and that they are used with a lamp of the recommended wattage.*

Ventilation

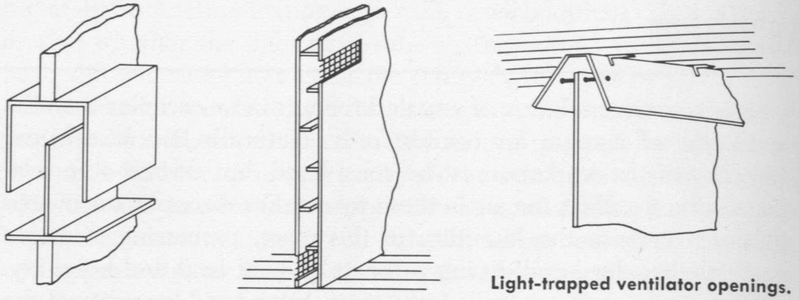
- Satisfactory ventilation of any darkroom is more complex than the ventilation of a room for comfort only. Naturally, the health and efficiency of the workers must be considered, but certain other elements directly affect the air in these rooms. For example, uncovered solutions increase the humidity in the room, processing solutions create slight odors, and drying cabinets give off heat and humidity.

When improperly controlled, the temperature and humidity of the air have adverse physiological effects on the workers, as well as physical effects on photographic materials during handling and storage. For example, excessive humidity causes the body to perspire, and damp fingers will readily leave marks on dry films or plates. If the air is too dry, film is susceptible to static accumulations. The dimensional stability of film, particularly important in the graphic arts and engineering reproduction fields, is affected by both temperature and humidity. In addition, lack of proper humidity causes the mucous membranes in the nasal passages of workers to become dry, and skin to become chapped.

Because the sensation of comfort varies with the individual, it is impossible to lay down a standard of comfort based upon temperature, humidity, and air movement which will be acceptable to everyone. Moreover, dry air at a high temperature will *feel cooler* than air of higher humidity but lower temperature. These factors can be correlated and applied to specific darkroom conditions by a competent air-conditioning company or engineer.

The incoming air should pass through suitable filters to remove dust particles. The air flow should be sufficient in volume to change the air in the darkroom 6 to 10 times an hour. The air change can be determined easily by ascertaining the cubic capacity of the room (length × breadth × height) and, with an anemometer, the air flow in cubic feet per minute as measured at the grill or intake. The cubic capacity is then divided by the number of cubic feet of air to determine the time required for one complete air change. To find the number of air changes that take place per hour, 60 is divided by the time in minutes for one complete change.

It is advisable to have the air in the processing room maintained at a positive pressure, that is, the air should be pumped *in* rather than *out*. This will prevent dust entering through crevices around windows and doors.



Light-trapped ventilator openings.

If it is not possible to bring air in through ventilating ducts, fans with lightproof intakes may be installed in the wall to draw air from an outside hall, room, or window. Doors and windows, if climate and season permit, can be equipped with lightproof louvers which permit the passage of air.

Several forms of light-trapped openings are illustrated above. The ventilated-partition arrangement shown on the right is perfectly satisfactory for printing rooms, although it may not be safe for a negative darkroom when the outer room is lighted. The other styles of vents shown will be quite safe, provided the inner surfaces are all painted a matte black to prevent the passage of any white light by multiple reflections. Lightproof louvers (nesting W type) are commercially available in a variety of sizes.

A definite pattern of air flow should be planned so that the fresh air is brought in at the "dry end" and exhausted from the "wet end." Thus, vapors from open trays and sinks will be exhausted quickly without traveling the length of the darkroom.

The drying cabinet must never exhaust *into* the processsing room. If an air-conditioning system is installed in the building, the use of air from the processing room for the drying cabinet may be undesirable as it might overload the ventilating system and upset the balance of the pressure and circulation. In such instances, the dryer should have separate ducts not connected with the air-conditioning system.

To insure air of proper quantity and quality, a competent heating and ventilating engineer should be consulted. The purification, humidification, and dehumidification of air may be maintained by equipment commercially available for individual rooms so that no large, expensive installation is necessary for individual darkrooms.

NOTE: *Local building codes and regulations must be observed in all of the above considerations.*

Plumbing

• Improperly designed plumbing can easily disrupt the routine in an otherwise efficient processing room. The materials should be selected carefully and installations made properly in order to avoid the troubles that occur as a result of an inadequate water supply or of corrosion or obstruction of the drainpipes.

Plumbing installation is most economical and efficient when all sinks and drains are located along outer walls of the darkroom area so that a common raceway can be utilized for all. This offers the additional advantage of making internal partitioning simpler and more flexible. Long runs of uninsulated, exposed piping should be avoided in order to minimize temperature fluctuations of the water supply.

Pipes supplying water to a sink should be placed high enough to provide a clearance of at least 15 inches between the sink bottom and the faucets. This allows room for a one-gallon jug or a standard 3½-gallon tank to be set in the sink beneath the faucets. It is suggested that the sink have at least two faucets—a swing spout with hot and cold water, and a cold-water faucet with a hose attachment for rinsing trays and other equipment.

Where rust and other foreign matter are present in the water system, the use of water filters provides inexpensive insurance against ruined negatives and prints.

WATER-SUPPLY PIPES

The size of pipe depends upon the amount of water to be used. In the average installation, a pipe 1 inch in diameter with branches ½ inch in diameter will suffice.

Galvanized-steel pipe can be used in installations where the plumbing is readily accessible for occasional inspection or replacement. However, this material is satisfactory only in localities where the mineral content of the water is not corrosive. Local plumbing codes should be consulted for guidance in regard to this matter.

Copper tubing is only slightly more expensive than galvanized steel and has the additional advantages of durability and ease of installation. It is particularly appropriate for concealed installations in walls or other inaccessible places where the use of tools would be difficult.

The use of brass or copper pipe affords the greatest possible permanence, but, if economy is a factor, pipe of these materials can be used for the hot-water supply and galvanized steel for the cold. This recommendation is made because hot water is more corrosive than cold water.

Cast-iron or galvanized pipes should not be fitted directly to stainless-steel sinks, but should be connected with brass or copper fixtures extending at least 4 inches from the sink. Iron and its compounds can destroy the passive nature of stainless steel and allow it to become corroded quite easily.

Two types of controlling valves—gate and globe—can be used in the water system. In use, the gate valve is either completely open or closed; it should not be employed to regulate the flow of water, because it is liable to be noisy. The globe valve is designed as a control and is quiet in operation.

DRAINAGE SYSTEMS

The drainage line must be ample to accommodate the maximum flow of water from the sink. It should be at least 2 inches in diameter.

The flow through the drainage line is determined not only by its size but also by the pitch of the pipe. The National Bureau of Standards and the National Plumbers Association recommend that the pitch be at least ¼ inch per foot. It is always good practice *to flush the drain with rapidly flowing hot water* after old processing solutions have been discarded through it. This is necessary to minimize corrosion and wash any sludge or gelatin that may be present.

If a septic tank is included in the drainage system, its activity may be impaired temporarily by an excessive amount of photographic solutions. However, it will regain its normal activity after sufficient dilution has taken place. With a 300 to 500-gallon septic tank, about 40 gallons of solutions per day can usually be disposed of with no adverse effects.

The nature of the chemicals carried into the drain requires that the line be constructed of acidproof and corrosion-resistant material. In addition, the pipes should be able to withstand rapid changes in the temperature of the water without cracking. It is true that many installations made with materials technically considered unsuitable have been used successfully over a period of years, but a wide margin of safety is insured by choosing a material that is resistant to full-strength processing solutions.

Knight-Ware.* This is a chemical stoneware that is resistant to corrosion by acids, alkalies, and other chemicals. Rapid and extreme changes in temperature will not affect this material.

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*Source: Maurice A. Knight, Akron, Ohio

Duriron.** This is an iron alloy that is resistant to corrosion by acids and alkalies. When this material is used, care should be taken not to pour into the drain very hot and cold water in quick succession, because extremes in temperatures may cause the pipe to crack.

Stainless Steel. Although it is expensive, 18-8 Molybdenum Stainless Steel, A.I.S.I. Type 316, is satisfactory for waste lines because of its great resistance to corrosion as compared with ordinary Stainless Steel, Type 304.

Cast Iron. This is the most commonly used material for waste pipes and fittings, although it will eventually rust in the presence of corrosive solutions. In quality, it should comply with Federal Specifications WWP-401 and be Grade Double Extra Strong.

Black Steel. This material is employed widely for drains, but the acid present in discarded fixer solution is liable to corrode it. Like cast iron, it should be Grade Double Extra Strong.

Galvanized Steel. In many localities this material is not acceptable for use as drainpipes because of its *relative* lack of durability and resistance to acids. However, for installations in which a short waste pipe is needed, it can be used if the entire line is readily accessible. It should not be installed in walls or floor slabs where it cannot be removed or replaced easily.

Brass and Copper. These metals are not recommended for waste pipes, since acids from fixer solution corrode them.

A two-sided sink in an "island" location provides room for several people to work at the same time without interference.

**Source: Duriron Co., Dayton, Ohio

Processing Sinks

• Careful consideration must be given to the design, placement, and construction of a processing sink. It should be large enough to take at least three trays of the largest size normally used and deep enough to avoid any danger of solutions splashing over the sides onto the workbenches or floor. If only one or two people will be using the sink at any given time, it can be located conveniently against a wall. However, in larger operations where several people will be using it simultaneously, it may be advisable to install a two-sided sink with work space all around it. Faucets, safelights, and shelf area can be mounted over the center of the sink.

Improper choice of materials may result in corrosion of the material itself, and faulty fabrication may cause leaks and shorten the useful life of a sink. Factors which must be considered in selecting the materials include resistance to the corrosive action of the solutions, mechanical durability, adaptability to fabrication, ease of cleaning, and appearance.

Stainless Steel. Stainless steel of the proper composition is very satisfactory, but there are many stainless-steel alloys that are *not* satisfactory for processing sinks. To say that a sink is made of stainless steel means little unless the "type" or composition is specified. Those steels possessing the highest resistance to corrosion contain about 18 percent chromium, 8 percent nickel, 2 to 3 percent molybdenum, and a maximum of 0.08 percent carbon. They are generally specified as A.I.S.I. (American Iron and Steel Institute) Type 316 of 18-8 stainless steel. Sinks or tanks made of these alloys are easily cleaned and are relatively inert when in contact with the solutions used in photographic processing. However, if bleach baths used in color processing are not rinsed off, they will pit any of the stainless steels.

Stainless-steel sinks for photographic use are manufactured by a number of companies.* However, for those who wish to have sinks made to order, the following suggestions should prove helpful.

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*Stainless-steel sinks and tanks are manufactured by a number of companies, including: Bar-Ray Products, Inc., 209 25th St., Brooklyn 32, N. Y.; Leedal Stainless Steel Products, 2929 S. Halstead St., Chicago 8, Ill.; Peck and Harvey, 5650 N. Western Ave., Chicago 45, Ill.; P.B. Polhemus Co., Inc., Roselle, N. J.; The Douthitt Corporation, 680 East Fort St., Detroit 26, Mich.; Calumet Manufacturing Co., 6550 N. Clark St., Chicago 26, Ill.; Grafic Stainless Steel Products, Inc., 1167 E. 43rd St., Chicago 15, Ill.; Oscar Fisher Co., Inc., 1000 N. Division St., Peekskill, N. Y.

In fabrication, these sinks should be carbon-arc or metallic-arc welded, but because of the excessive heat introduced, should never be welded by the oxyacetylene method. The heat produced by the welding process must be kept at a minimum, and the carbon content of the weld metal must be low to prevent the formation of excessive carbides during welding.

Stainless steels have a coefficient of expansion almost 50 percent greater than that of the mild steels. Therefore, correct welding fixtures and clamps should be employed carefully to prevent strains and distortion. Excessive distortion can be prevented by applying a stream of water to the back of the seam as the welding progresses.

Outside seams should be used wherever possible. When inside seams are necessary, however, corner seams should be avoided because of the difficulty in grinding and polishing. All inside joints should be ½ to 1 inch from the corners.

After fabrication, the resistance of stainless steel to corrosion can be increased by a protective treatment known as "passivation." The action of this treatment is twofold: It aids in the development of the thin surface film of oxide upon which stainless steel depends for its corrosion resistance, and it removes any corrodible materials, such as iron particles, that have been embedded in the surface of the stainless steel.

The method of application is to immerse the sink for ½ hour in a solution of nitric acid, mixed 20 percent by volume with water at 140 to 160 F. If the sink is too large to be treated by this method, a cold solution of nitric acid, mixed 30 percent by volume with water, should be poured into it and sloshed around for ½ hour with a broom. A thorough rinsing with cold water completes the process.

> CAUTION: *Wear rubber gloves, protective clothing, safety goggles, and a gas mask for acid fumes. Treat in a fan-ventilated chemical hood or outdoors.*

Lead-Lined Wood. Lead fabricated in a wooden form or box results in a structurally sound sink if the seams are "burned" and not soldered. This sink is easily cleaned and relatively inexpensive. Since it depends for watertightness on the lining rather than the wood, the selection of the wood is not as limited as it is for an all-wood type of sink.

The wooden shell of a metal-lined sink does not have to be watertight. However, tie rods are necessary at the ends, at the partitions, and at the bottom to keep the sides from buckling. Tongue-and-groove joints should be used for this construction.

The medium grade of lead lining, weighing either 6 or 8 pounds to the square foot, should be used. The equivalent thicknesses are 3⁄32 and ⅛ inch, respectively. The joints should be welded with lead rather than soldered. This prevents any possible electrolytic action between the two metals, which would cause leaks.

Stone. Fine-grain stone without cleavage planes is suitable under certain conditions. Stone having cleavage lines, such as slate, is not recommended because it often splits. Also, some soapstones eventually disintegrate in the presence of fixer solution. Of all the varieties of soapstone, Alberene Stone, Grade 25, is one of the most resistive to fixer solutions. Although sinks of this material are likely to crack from the excessive heat of hot water, they have proved very satisfactory when lined with tile assembled with cement.

Stoneware. Among manufacturers, the term "chemical stoneware" is employed loosely for materials composed of earthenware that is glazed on all surfaces. These materials, either clay or clay mixed with sand, are satisfactory as long as the glaze is unbroken. When the glaze is broken, however, the solutions penetrate the cracks and fissures and crystallize, causing general disintegration.

Stoneware, such as that manufactured by the U. S. Stoneware Company, is vitrified or burned to a glasslike surface during manufacture so that it does not require surface glazing.

Wood. Wooden sinks and tanks have been known to give good service over long periods of time. Their chief advantages are low cost and ease of construction. Among the disadvantages are their somewhat crude appearance and their tendency to accumulate slime on the inner surfaces.

Louisiana Tidewater Red Cypress (heart quality) is best for constructing processing sinks made entirely of wood. The dressed thickness should be at least 1⅜ inches, since the plank must be counterbored to accommodate the 1-inch washer commonly used with a ⅜-inch tie rod. This wood is usually obtainable in 10-inch and 12-inch widths. This width makes it possible to use single boards for the sides of an all-wooden sink.

In assembling the sink, the ends and partitions are mortised to the sides; the bottom is similarly mortised to the ends, sides, and partitions. The planks are joined to form panels for the bottom. All the elements (sides, bottom, and end partitions) are held in position by tie rods. It has been found that butt joints are more desirable than tongue-and-groove joints for all-wooden sinks because the panels can be tightened more successfully by the tie rods as shrinkage occurs.

The unevenness of tongue-and-groove joints makes them difficult to take up, and excessive swelling is likely to cause buckling as well as splitting in the joints of wooden sinks.

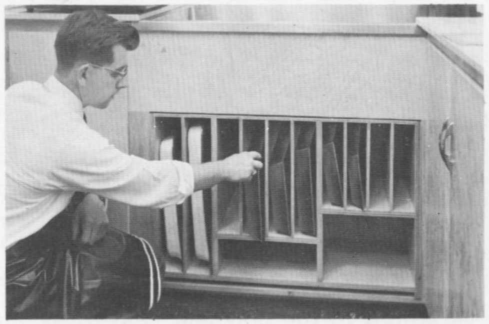
Wooden sinks can be supported on concrete or timber cribbing or on steel feet. Supporting beams should run crosswise to the bottom.

Fiberglas. There has been a recent increase in the use of Fiberglas cloth as a covering for darkroom sinks built of plywood. The sink is lined with the Fiberglas material and coated with a polyester or epoxy resin to insure a waterproof seal. The material is not affected by most ordinary photographic solutions, but continuous contact with dichromate-sulfuric acid bleach baths should be avoided. It may in time become stained by developers, and hot water may soften and distort it. Both the cloth and resin can be obtained from most marine supply stores. The instructions for applying them to boats can be adapted easily for sinks.

OTHER FEATURES

Duck boards of moisture-resistant cypress should be used in the sink. These should be made in sections so that they can be removed readily for cleaning the sink. If the slats are triangular-shaped instead of flat, more water will come in contact with the bottoms of developing tanks, making it easier to control the temperature of processing solutions. Also, splashing of spilled solutions will be minimized.

The most convenient method of tray storage is to stand them vertically between separators in a removable tray rack, as illustrated. It permits easy access and cleaning of the storage area, and at the same time allows wet trays to drain. In addition to the tray racks, shelf space can be provided under the sink for chemicals, extra tanks, and other processing equipment.



Cleaning of the storage area under the sink is easy when the tray storage rack is removable.

Water-Temperature Control

• Accurate and consistent control of the conditions under which photographic materials are processed, particularly control of the temperature of the processing solutions, is desirable in all cases and is a necessity in photomechanical work and in work with color materials.

When only small quantities of photographic materials are to be processed, it is possible to get along with manual adjustment of temperature. For example, the drain of the darkroom sink can be fitted with a standpipe, and water from an ordinary mixing faucet can be allowed to overflow from the washing tank and surround processing tanks to the level of the standpipe. With such an arrangement, a thermometer placed in the water flow must be watched constantly to make sure that varying loads on the water-supply lines are not allowed to change the temperature of the mixture.

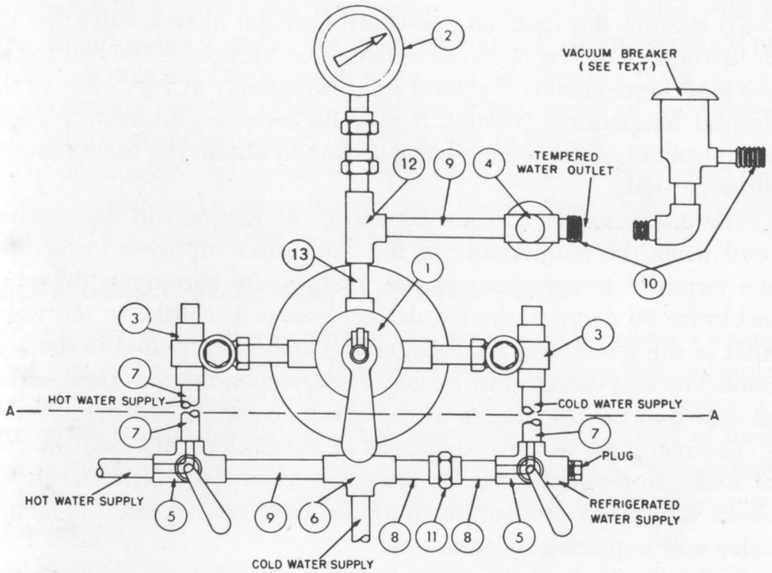
When appreciable quantities of sensitized materials must be handled on a production basis, however, a more accurate and dependable temperature-control system is almost a necessity. With such a system, as discussed below, mistakes and delays can be avoided, and savings in time and materials will quickly repay a reasonable investment in equipment.

MIXING VALVES

Thermostatically controlled, manually adjusted mixing valves provide the most compact and least expensive of the systems available for the control of water temperature.

These valves operate by mixing warm and cold water to obtain the desired temperature. Therefore, the temperature of the cold-water supply must, of course, be at least as low as, and preferably lower than, the temperature required for the mixture. In areas where the cold water during the summer months is warmer than the desired temperature, an auxiliary cooling system is necessary. This, in turn, necessitates a few additional fittings to permit switching the unit from the normal use of existing hot- and cold-water supplies to the use of cold and artificially cooled water. In winter months there will seldom be any necessity for a refrigerated water supply.

There are several of these automatic mixing valves on the market. The one chosen should have a capacity of at least 3 gallons per minute, should normally control the mixed-water temperature within plus or minus ½ F or less, and should recover quickly from pressure variations in the hot- and cold-water lines. The temperature range over which it can be adjusted should include the temperatures required for the various photographic processes that are likely to be handled in the darkroom.



Plumbing diagram of a water-temperature control unit incorporating a thermostatic mixing valve.

The plumbing diagram shows a typical setup for operation of a thermostatic mixing valve. The main part of the unit is shown above the line A-A and includes four special parts as follows:

1. Thermostatic mixing valve
2. Dial thermometer (with bulb inserted in outlet pipe)
3. Check valves with strainers
4. Globe valve (for controlling flow at outlet)

When artificially cooled water must be used at certain seasons, the parts shown below the line A-A are required. The two 3-way cocks provide a simple means for shifting the input to the mixing valve from hot water plus the regular cold-water supply to cold water plus refrigerated water.

The tees, nipples, unions, etc, needed for the connections are standard plumbing parts. Note particularly the hose transfer nipple (10) for connecting a hose coupling to the outlet. The lengths of the various nipples will depend on the size and design of the particular mixing valve used.

To operate the unit, set the control on the mixing valve for the desired temperature, open the outlet valve, and check the reading on the dial thermometer. It should stabilize quickly at very close to the desired temperature, though it may be necessary to make a slight readjustment of the mixing-valve setting to obtain the exact temperature desired.

The 3-way valves (5) are shown in the diagram in the position used when the temperature of the cold-water supply is lower than the required temperature of the mixture. By turning both valves clockwise 90 degrees, the regular cold water is shifted to the warm inlet of the mixer, and the refrigerated water is supplied to the cold inlet. The two valves must be kept in corresponding positions, either as shown in the drawing or at the alternate setting just described.

The regulated water is delivered at the outlet (10), and the rate of flow can be controlled by the globe valve (4). Strainers in the check valves (3) prevent dirt particles from getting into the mixing valve and impairing its operation.

In localities where the water is extremely hard, the mixing valve may require occasional cleaning. The instructions supplied by the manufacturer should be followed carefully, particularly with regard to the tools and type of cleaning compounds to be used.

VACUUM BREAKER

If the regulated-water line is coupled directly to a water jacket or wash-water tank below the surface of the water, the local plumbing code may require the use of a vacuum breaker on the outlet from the temperature-control unit. The vacuum breaker will prevent the water in the tank from being siphoned into water-supply lines and contaminating them in case the main water supply fails or is shut off and a vacuum develops.

AN ECONOMICAL COOLING SYSTEM

When an auxiliary cooling system is required, the artificially cooled water is connected to the tap marked "Refrigerated-Warm Supply" in the plumbing diagram on page 33. An economical cooling unit can be made easily. Such a system is adequate when the temperature of the cold-water supply is too high for only a short period of time. A 50-foot length of ½-inch copper tubing is wound into a coil 1½ feet in diameter, fitted with garden-hose connectors, and placed in an ordinary ash can. With about 100 pounds of ice broken into small pieces and placed in contact with the copper coil, such a unit is capable of lowering the temperature of incoming water with a flow rate of about 1 gallon per minute about 4 F during a period of 4 hours. A greater drop in temperature can be obtained, if necessary, by decreasing the rate of flow, increasing the length of the tubing and the size of the container, or adding salt to the ice.

The auxiliary cooler should be installed in the darkroom so that the bottom of the container is higher than the existing drain. A drain cock can then be installed in the bottom of the metal can.

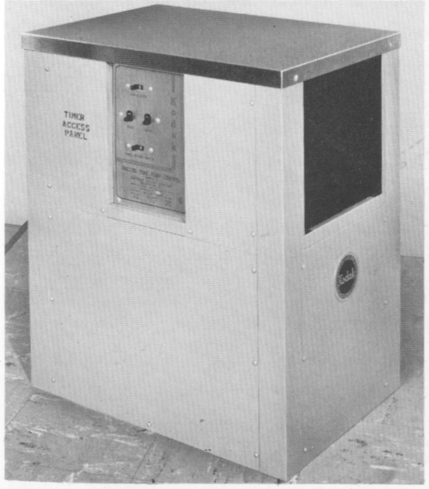
MECHANICALLY REFRIGERATED WATER SUPPLY

Although a mechanically refrigerated water supply system is somewhat expensive, it is usually feasible if there is more than a single darkroom. Furthermore, such a system must be used if the temperature of the cold-water supply is too high over a long period of time or if a substantially greater cooling capacity is needed. Information on suitable equipment can be obtained from local refrigeration representatives.

TEMPERATURE-CONTROLLED SINKS

Several very satisfactory temperature-controlled processing sinks are now available. There are two basic types. One type has a built-in refrigeration unit with cooling coils under the sink. This type maintains a shallow level of water at a constant temperature. The other type has no coils directly under the sink, but circulates water at the required temperature continuously through a built-in mechanical cooler.

Details on these can also be obtained from local refrigeration representatives.



The Kodak Precise Time-Temp Control, Model 4, provides a high degree of accuracy in the control of processing-solution temperatures. It includes a cooling unit, immersion heater, thermostat, heat exchanger, and pump for circulating water from a processing-tank jacket. The processing solution is held within plus or minus ½ F of the desired temperature.

Dry Bench

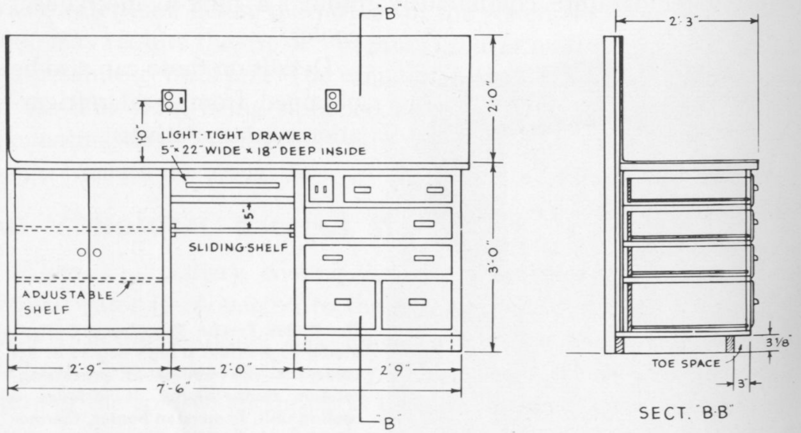
- The dry bench is where sensitized goods are handled and stored. It should be located on the dry side of the darkroom, away from wet areas such as sinks and chemical-mixing benches.

Like all darkroom equipment, the bench should be so constructed and located that its use requires a minimum of walking and the least amount of arm and body motion. The desirability of saving physical exertion is obvious when each processing procedure is regarded as a series of related motions that must be performed efficiently.

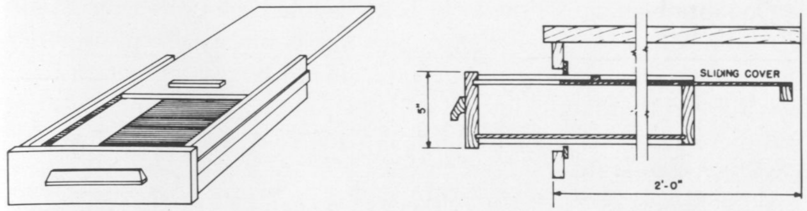
The length of the bench depends on the volume of work and the space available. In a film-processing room, the suggested minimum length is 4 feet. This allows room for removing films from holders and placing them in hangers, plus space for stacking the holders and hangers during the operation. In the printing room, there should be space to accommodate all of the enlargers and contact printers, plus sufficient working space for handling the printing paper.

The proper height of a bench for the average standing person is 3 feet. The depth is determined by the distance a person can reach easily without undue leaning or stretching—24 inches is recommended.

To provide storage space for supplies and accessories, a combination of drawers similar to the unit illustrated is recommended. A lighttight drawer in which to store opened packages of photographic materials can be built according to the diagram. The cover of the drawer is fitted in grooves at the front and sides so that, when the drawer is closed, the cover is pushed tightly against the front. Since the cover remains in this position until it is pushed back manually, the drawer is lighttight when pulled open. This cover should be made of a material which is heavy enough so that it will not sag and fail to fit into the groove at the front of the drawer.



Suggested dimensions of a dry bench. Convenience outlets and switches are built into the bench.



Details of a lighttight drawer for storing photographic materials.

An integral wiring system might be desirable for the dry-bench unit. Three separate circuits are found in the bench illustrated. The convenience outlet, with a switch above the bench, provides an outlet for the various electrical devices, such as timers, clocks, and printing lamps. The other convenience outlet is controlled by the right-hand switch in the front center space. On the bench itself, a snap switch to control the safelights is especially useful if a photographic enlarger is used, because it is easier to focus an enlarger without a safelight shining down on the easel.

COVERING BENCH TOPS

Bench tops should be chemically inert, watertight, and fairly resistant to abrasion. Good-quality, solid-color linoleum is an economical topping material. If possible, it is desirable to carry the linoleum up on the back of the bench to form a splash shield. A curved junction can be achieved by using 1½-inch cove molding under the linoleum where the bench joins the back of the bench or sink. This arrangement forms surfaces which are free of "dust catchers" and therefore are easy to clean.

Linoleum can be fastened to the bench top by means of waterproof linoleum cement. To relieve the strain on the cement, the linoleum should be tacked in place at the upper edge of the vertical splash shield.

One disadvantage of linoleum is that spilled solutions after a time may attack it, softening it and roughening its surface. To prevent the penetration of solutions, the linoleum should be treated with a hard wax rubbed thoroughly into its surface. Another disadvantage is the static created when film rubs against linoleum, attracting dust and possibly fogging the film.

Vinyl materials, available in sheet form, can be installed on bench tops in much the same manner as linoleum. Vinyl is somewhat more expensive than linoleum, but does not become stained or softened by spilled solutions.

One of the most durable materials is sheet plastic, such as is used for restaurant table tops and counters. The extremely hard surface will not dent or scratch readily and, in many instances, is resistant to stains and corrosion. Obtainable in a wide variety of attractive colors, it is usually laminated to plywood, making installation easy.

Composition floor tiles have also been employed. If a large size, 12 by 12 inches or 12 by 18 inches, is used and the joints are leveled carefully, a very durable top will result.

The most satisfactory covering material for benches adjacent to sinks or to any other water supply is stainless steel, Type 316. This sheeting can be formed to fit present benches or a tinsmith can devise a new unit to fit particular needs.

Wooden bench-coverings can be used if proper care is maintained. Hard maple is quite serviceable if it is kept thoroughly waxed and polished.

The color of the bench top should be chosen with the thought that film, interleaving paper, pencils, boxes, and other objects must be readily distinguished on its surface under safelight illumination. Colors that are satisfactory can be determined by viewing a color card, obtainable from a dealer in paint supplies, under both white and safelight illumination. A checkerboard pattern of alternate light and dark squares also proves helpful in this matter. Black or deep green is not too satisfactory because of the difficulty in seeing dark objects against them. Likewise, a light cream or buff is so near the color of unprocessed film as to render it indistinguishable.

STORAGE FOR HANGERS

Film hangers are usually stored on brackets either above or below the loading bench, whichever is preferred. The hanger should be kept so that it can be removed from the brackets by grasping one of its bottom corners, in order to preclude unnecessary turning of the hanger to get it in position for loading. The hangers stored above the bench should be hung with the crossbars uppermost, while those below the bench top should be suspended with the crossbars downward. Brackets for hanger storage should have rounded or padded ends to prevent serious injury if a person should hit against one of them in the dark.

Sliding doors on the storage cupboards require less operating space and eliminate the danger of hitting against hinged doors standing open in the dark.

GENERAL STORAGE

Above the benches, wall shelves or overhead cupboards provide convenient storage space for such items as packaged chemicals, towels, and small accessories. The bottoms of these units should be at least two feet above the bench top. Shelf width of about 10 to 12 inches is adequate.

WASTEPAPER RECEPTACLE

The accumulation of film boxes, wrapping paper, and other waste is a constant problem if facilities for disposal are inadequate. The simplest procedure is to have a suitable basket, fiber box, or barrel located conveniently near the bench but placed so that it does not interfere with traffic. Waste film should be disposed of in a separate, fireproof container. This safety precaution is required by many insurance companies.

Loading, Mixing, and Finishing Rooms

LOADING ROOM

If one person is usually working in the film-processing room while another is taking pictures, it is highly desirable to have a separate room for loading film holders. It eliminates the possibility of interference with the film-developing operation and removes the danger of ruining unexposed film with processing chemicals.

For convenience, the loading room should open into the camera room. It need not be much more than a lighttight closet containing a small workshelf, table, or bench, with space for storage of holders and film. A single overhead light should be installed for use when cleaning up the room. Suitable ventilation should be provided for safety and comfort.

An air hose for blowing the dust out of holders before they are loaded can save much time and money spent in spotting dust holes in negatives. The air can be supplied by a system built into the building, a small motor and compressor, or a tank of compressed air obtained from a local supplier.

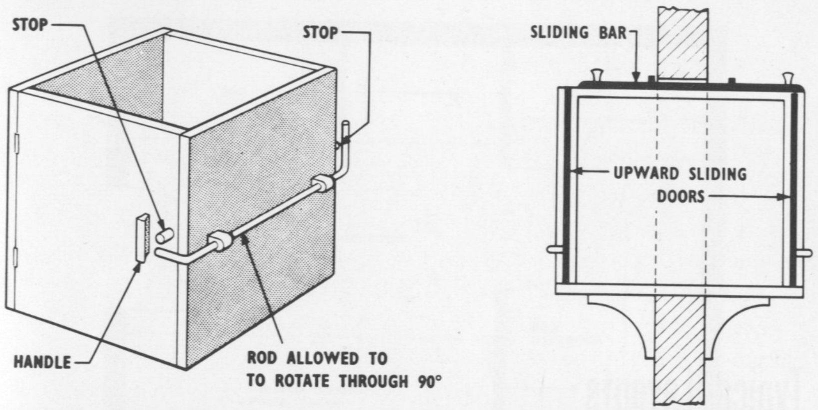
CHEMICAL MIXING ROOM

For maximum convenience and to protect equipment and materials against chemical fumes and dust, it is preferable to mix chemicals in a room apart from the darkroom or laboratory. The area need not be large, because its use is sporadic. Obviously, the ventilation system should be such as to avoid transfer of air from such a room to the rest of the department.

A convenient unit for the mixing room consists of a cabinet into which a sink has been built. Storage space is provided underneath for mixing apparatus and on shelves above for packaged chemicals. The faucet should be located to one side rather than centered, so that it will not interfere with tall bottles or tanks. Both hot and cold water should be available for mixing solutions. A wooden rack in the sink will minimize the breakage of glassware and chipping of enamelware.

FINISHING ROOM

All print-finishing operations that can be done in white light should be carried out in a separate finishing room, space permitting. This room should be located adjacent to the printing room to allow the smoothest and most efficient flow of work. Here the prints can be washed, dried, mounted, spotted, and prepared for delivery. Negatives can be retouched in a corner of the room.



The pass box on the left is a type commonly used. However, there is nothing to prevent the opening of one door when the other is open. Only one door at a time can be opened on the pass box shown at the right.

A pass box, or pass window, near the sink in the printing room will make it possible to transfer the prints directly to the finishing room without the necessity of walking from one room to the other. This is a light-trapped cupboard mounted in the wall between the two rooms. It should be arranged so that it can be opened from either side, but only when the opposite side is closed. This can be done by using a flexible curtain, built like the roll top of a desk, extended around the end of the cupboard and long enough so that one opening is not uncovered until after the other is completely closed. Or, sliding or hinged doors can be used on each side, with catches arranged so that opening either door locks the other one.

In the finishing room, the print washer should be located beneath or beside the pass window for greatest work economy. Each successive operation—drying, trimming, mounting, spotting, and wrapping—should be located just a few feet from the previous step. Any backtracking results in lost time and motion.

Workbenches and cabinets should have shelf and drawer space for all materials used in the finishing operations. Mounts, mounting tissue, and other materials stored in cabinets or drawers are easier to use and less likely to become damaged than when stacked on top of a table or stored in the original packing boxes on a shelf.

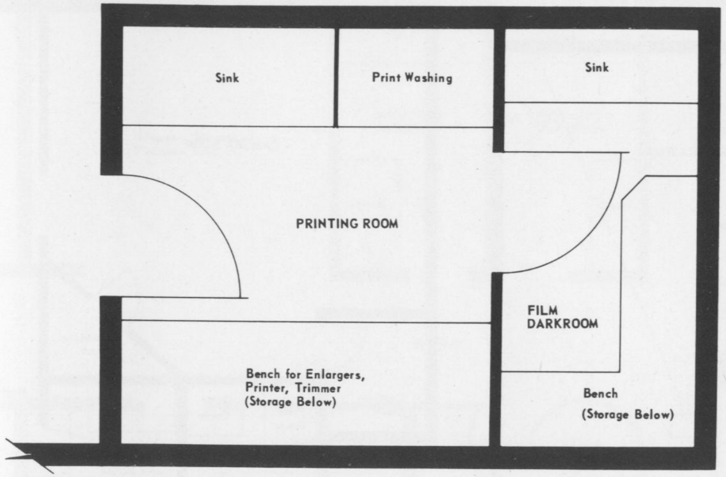
Special attention should be paid to the general illumination in this room. This is where the final product receives the finishing touches, and the lighting should be adequate and well diffused so that all details can be seen clearly.

Typical Layouts

- The layouts on the following pages are presented as examples of typical situations that may be encountered in designing darkrooms. Each was prepared in the Sales Service Division of the Eastman Kodak Company to fit the available space and the work requirements of a specific photographic establishment. In each layout the work flow pattern was made as smooth and continuous as space limitations would allow, although it was sometimes necessary to compromise.

The layouts were selected to illustrate solutions to various problems which might be encountered in the planning stage. In some instances it may be possible to adapt one of these layouts with relatively few changes. Usually, however, only a few ideas can be obtained from any single layout, and it will be necessary to make a sketch which incorporates appropriate elements from several of the layouts. In either case, the resulting tentative layout can serve as the basis for discussion with the architect or builder.

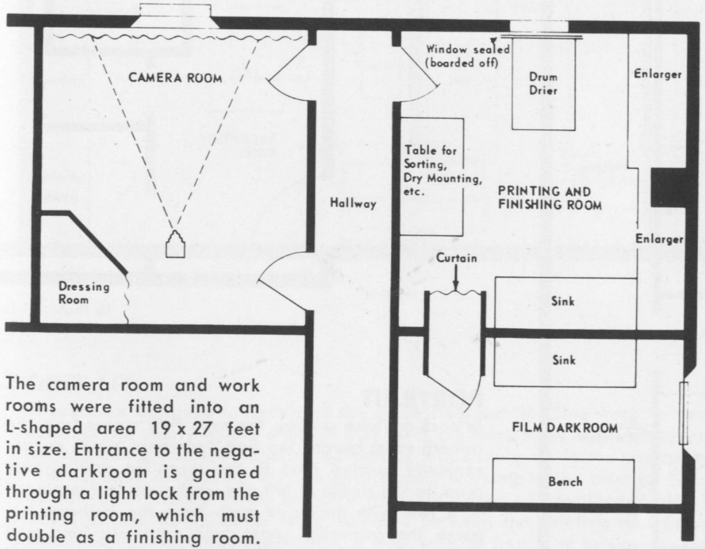
The scale, indicated with each layout, is ⅛ inch = 1 foot in most cases. However, it should be noted that there are some exceptions.



¼ inch = 1 foot

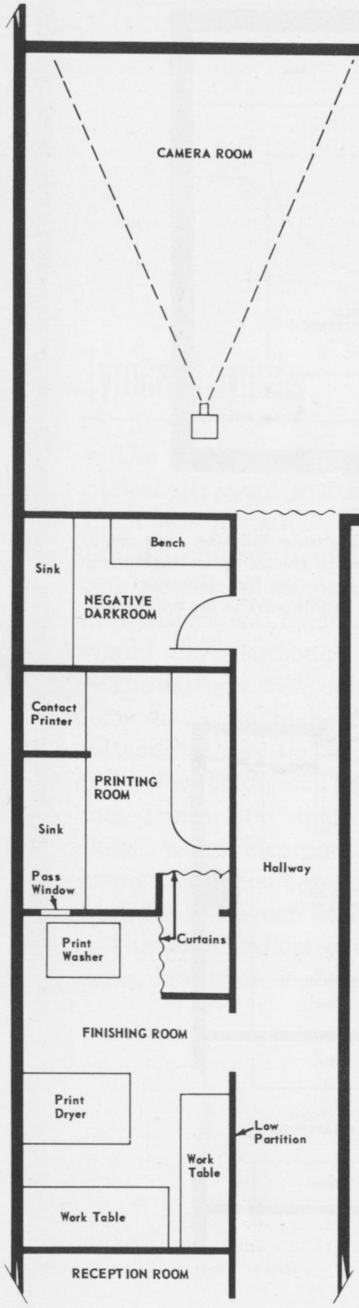
PORTRAIT

Due to the limited space available here, 8½ x 12 feet, a separate finishing area could not be provided, and finishing must be done elsewhere in the studio. Space limitations also make it necessary to go through the printing room to reach the film darkroom. This does not cause much inconvenience, because only one or two people work in the darkrooms.

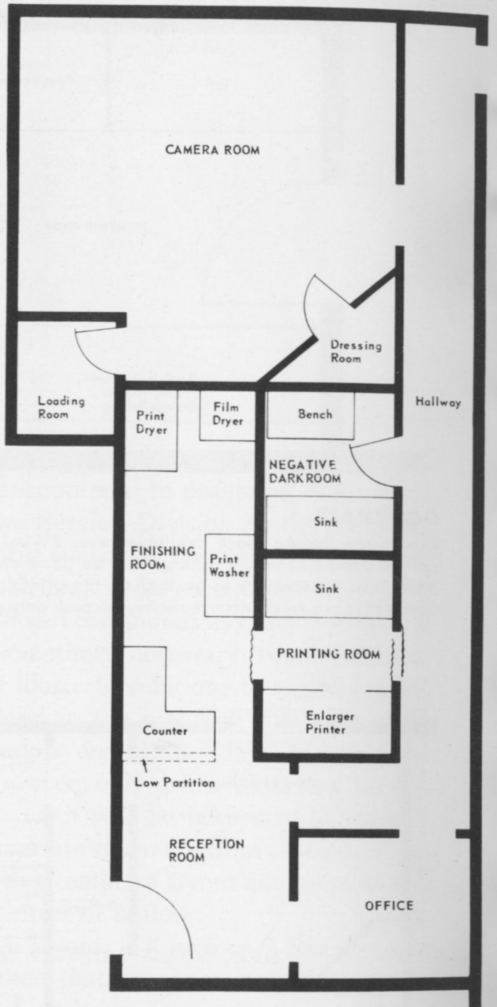

CAMERA ROOM
Dressing Room
Hallway
Window sealed (boarded off)
Drum Drier
Enlarger
Table for Sorting, Dry Mounting, etc.
PRINTING AND FINISHING ROOM
Enlarger
Curtain
Sink
Sink
FILM DARKROOM
Bench

The camera room and work rooms were fitted into an L-shaped area 19 x 27 feet in size. Entrance to the negative darkroom is gained through a light lock from the printing room, which must double as a finishing room. Windows in the darkrooms are sealed off. It was necessary to fit the enlarging bench around a large post.

⅛ inch = 1 foot



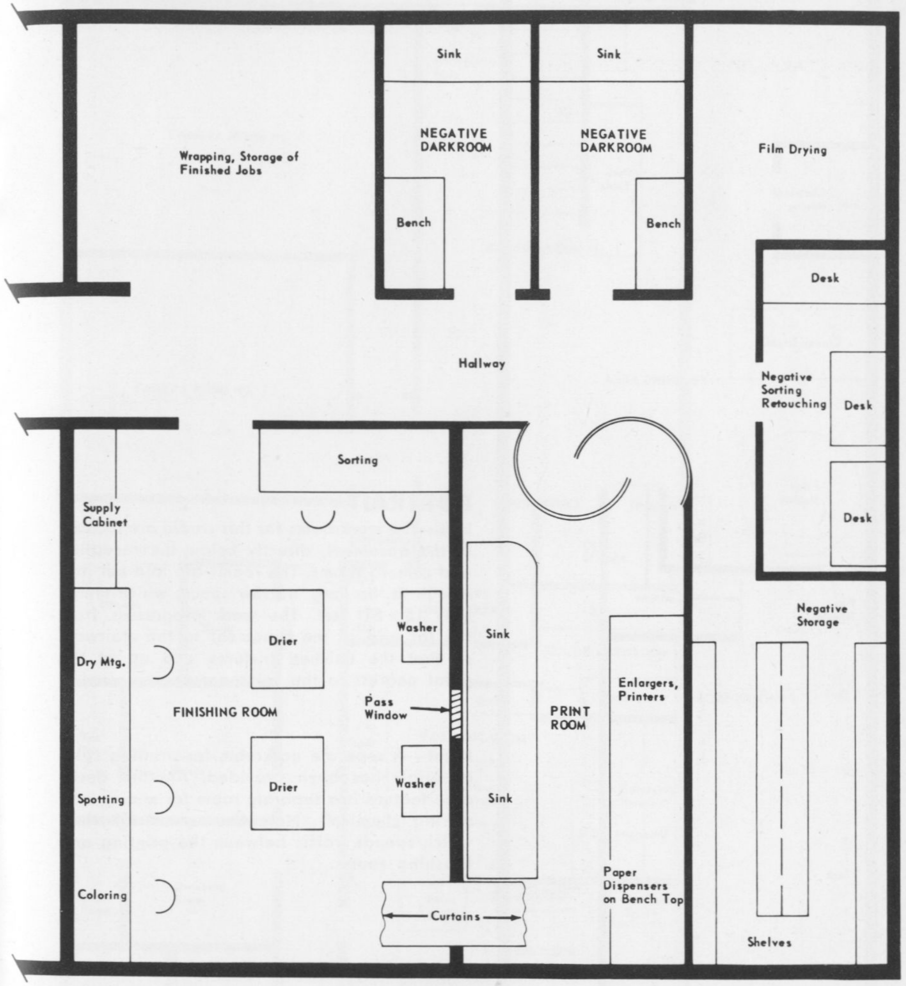
1/8 inch = 1 foot



1/8 inch = 1 foot

PORTRAIT

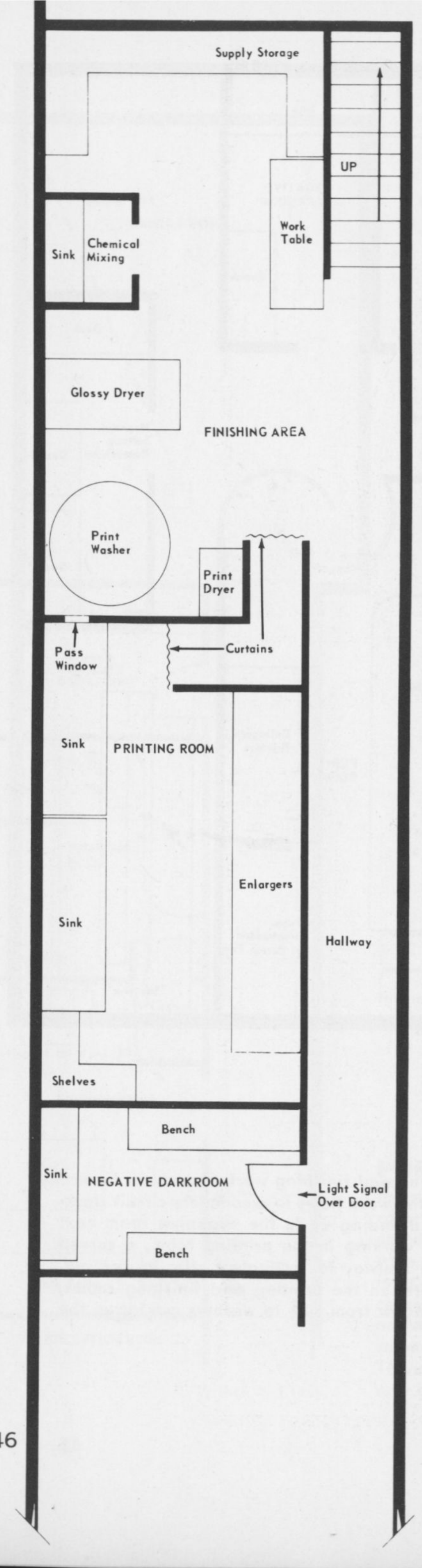
In each of these studios, the work flow moves from the camera room toward the finishing room, which is conveniently located next to the reception and display area. In the studio at left, the work rooms were placed in a row with access to each from the hallway, because the available space was relatively long and narrow (13 x 30 feet). The area available for work rooms in the above studio was shorter (14½ x 15 feet). Therefore, it was necessary to make the rooms smaller and group them as shown.



1/8 inch = 1 foot

PORTRAIT

This area was designed to handle all the processing and finishing work for several branch studios. In the nearly square area (34 x 39 feet), the work flows in a complete circuit clockwise, beginning with the negative darkrooms and ending up in the wrapping room next to the negative darkrooms. With several people working in the printing room, a curved labyrinth was installed in the entrance from the hallway to facilitate traffic in and out. Because of insufficient space for a labyrinth between the printing and finishing rooms, a curtained light lock was substituted. A pass window from sink to washers cuts down the traffic between the two rooms.

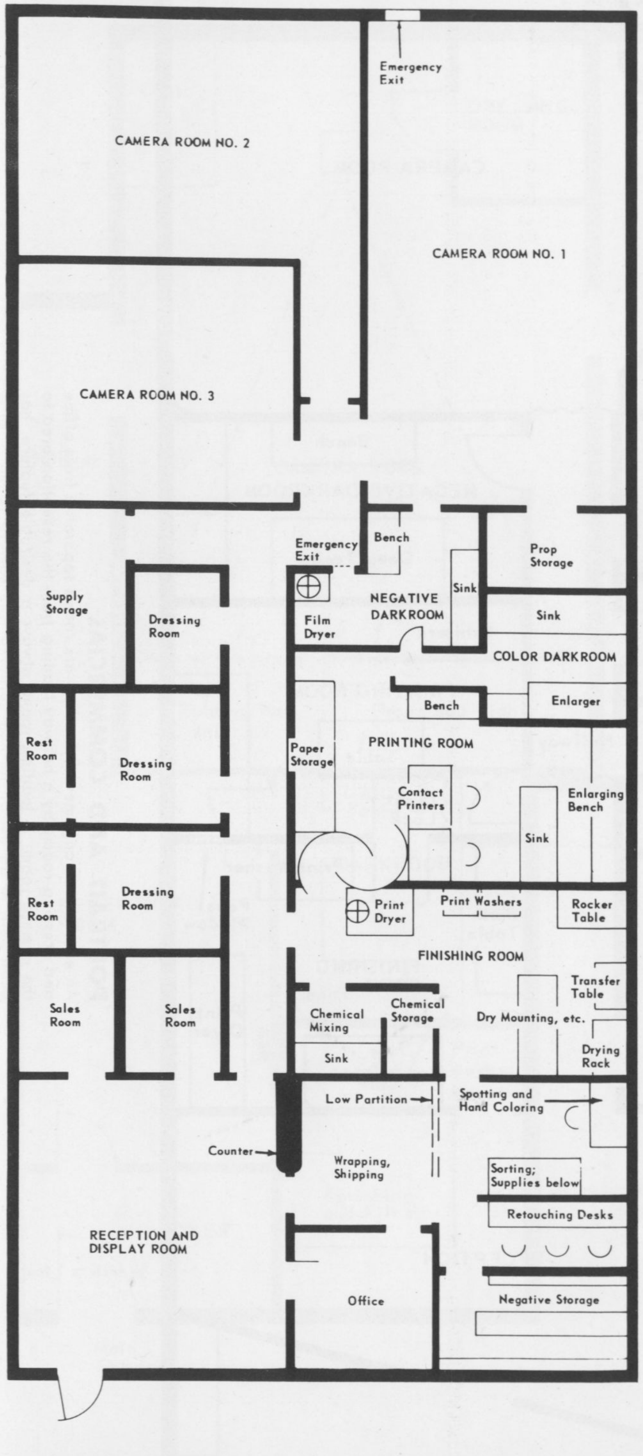


PORTRAIT

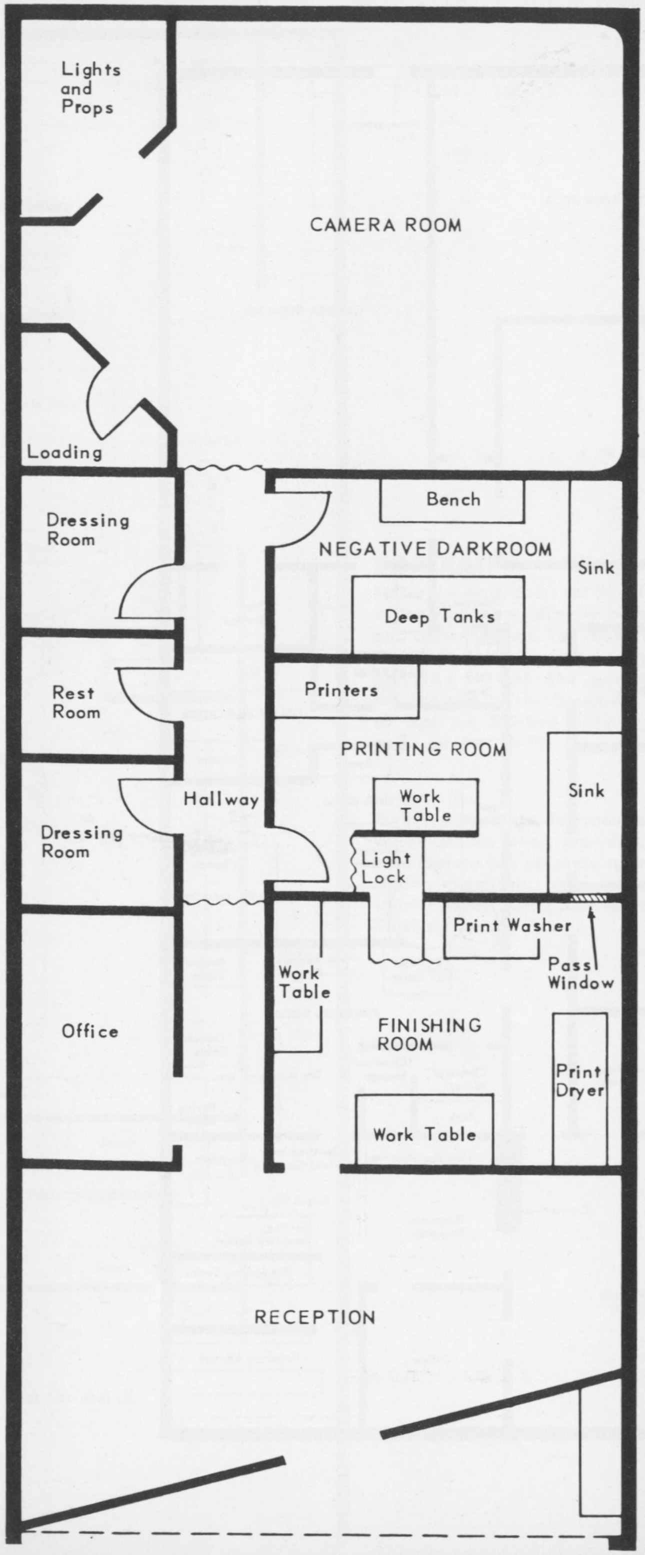
Left—The workrooms for this studio are located in the basement, directly below the reception and camera rooms. The rooms are laid out in a row to fit the long, narrow space, which measures 15 x 51 feet. The work progresses from the far end of the basement to the stairway, so that the finished pictures end up at the point nearest to the sales area.

Right—A separate darkroom for printing color materials has been provided. Another desirable feature is a separate room for mixing and storing chemicals. Note the curved labyrinth which speeds traffic between the printing and finishing rooms.

⅛ inch = 1 foot



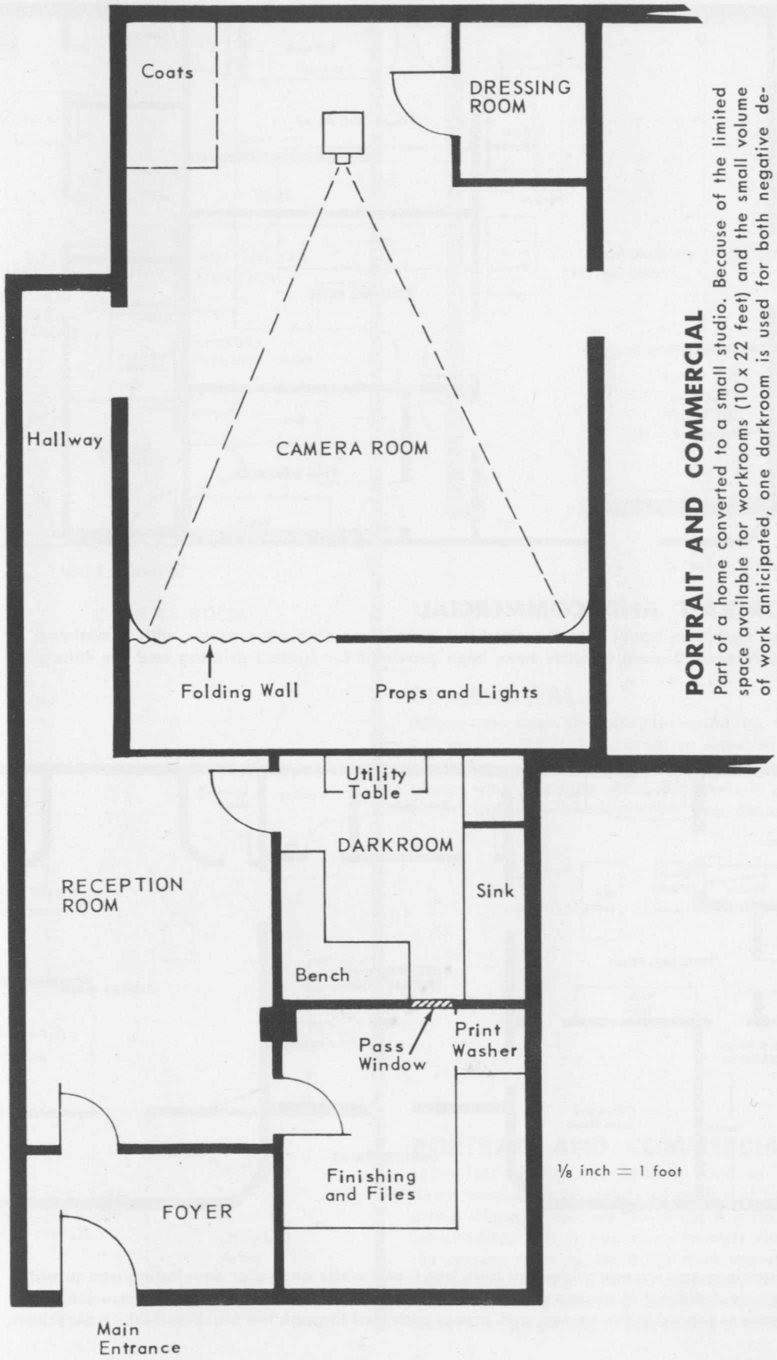
1⁄16 inch = 1 foot



⅛ inch = 1 foot

PORTRAIT AND COMMERCIAL

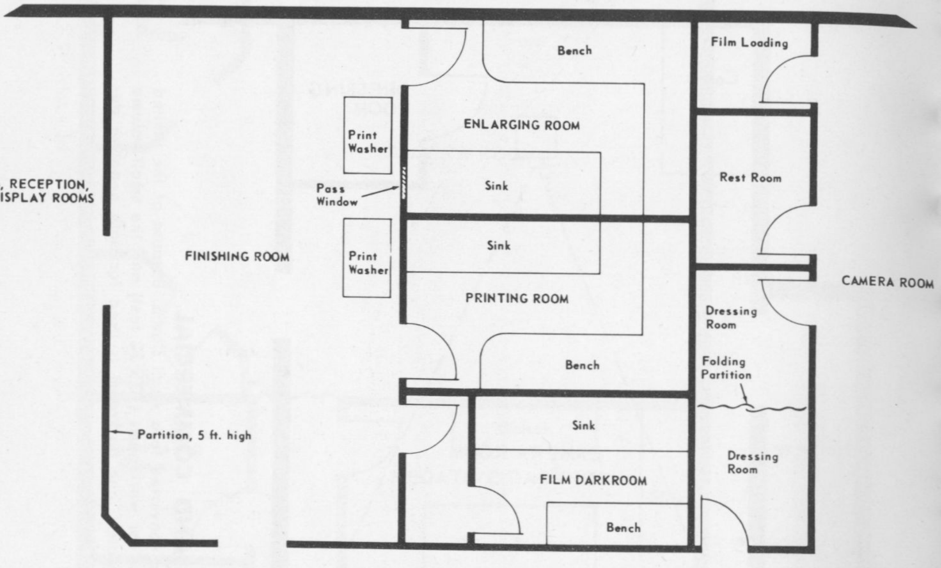
An excellent arrangement, with the work rooms separated from office and dressing rooms by a hallway leading from the reception area to the camera room. A loading room, always a desirable feature, has been built in an out-of-the-way corner of the camera room.



⅛ inch = 1 foot

PORTRAIT AND COMMERCIAL

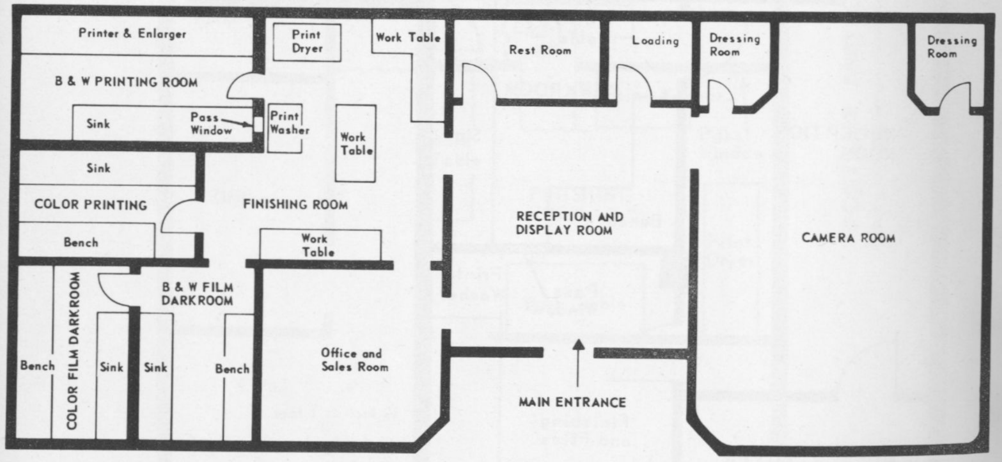
Part of a home converted to a small studio. Because of the limited space available for workrooms (10 x 22 feet) and the small volume of work anticipated, one darkroom is used for both negative developing and printing.



⅛ inch = 1 foot

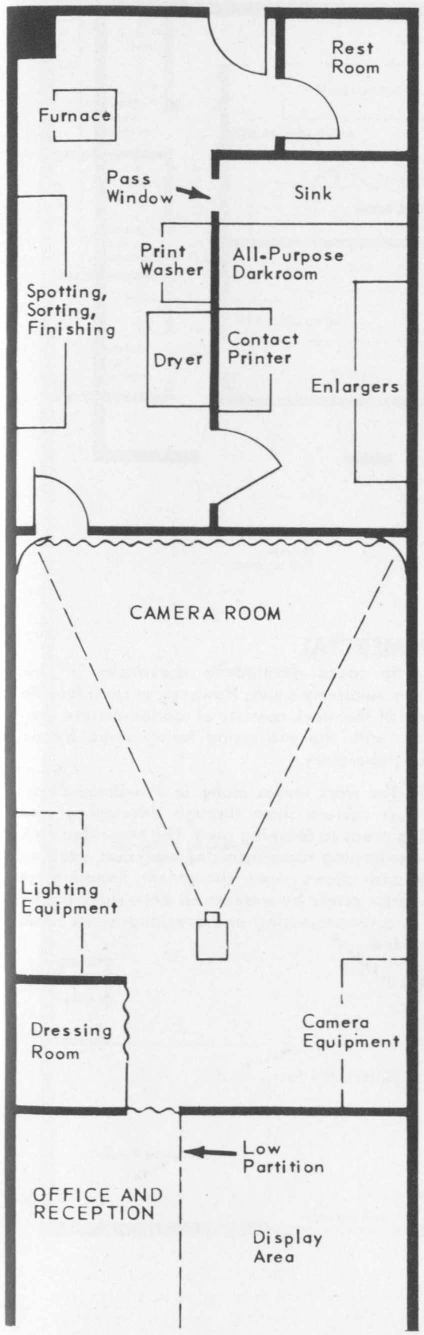
PORTRAIT AND COMMERCIAL

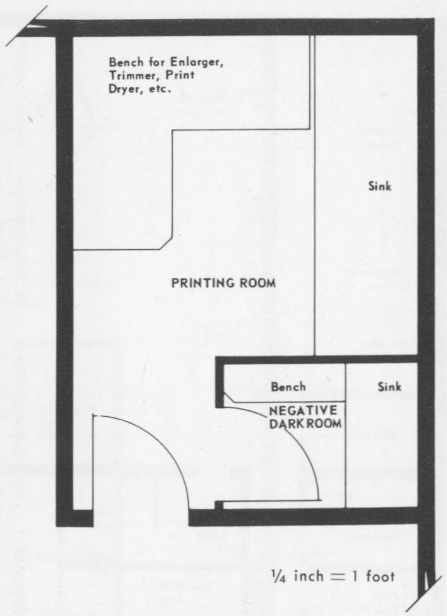
Each darkroom opens into the finishing room, providing easy access with a minimum of interference. Separate rooms have been provided for contact printing and for enlarging.



1/16 inch = 1 foot

Separate rooms were provided for both black-and-white and color developing and printing. The layout did not allow separate entrances for both film darkrooms, so the less-used color room was placed in the corner, with access provided through the black-and-white darkroom.





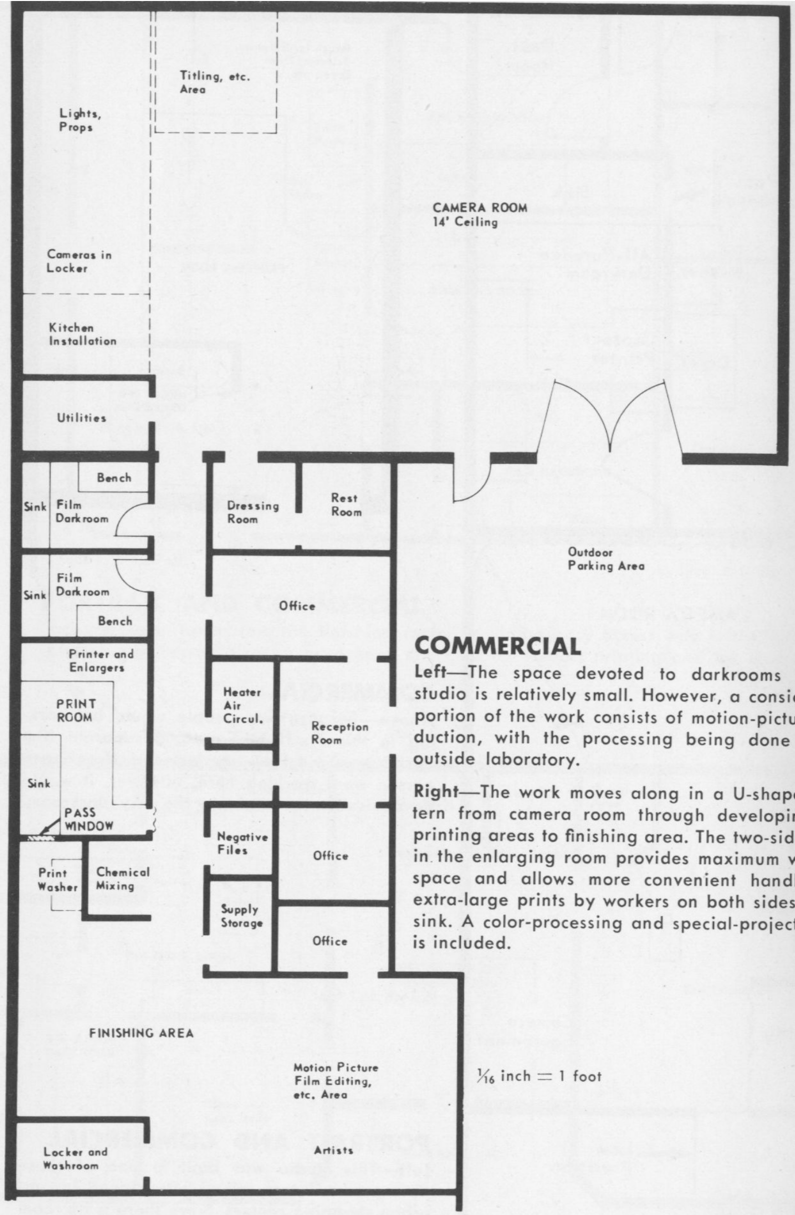
COMMERCIAL

Above—Because two people would be working in this 7 x 10-foot area, a separate film darkroom, 3 x 4 feet, was included. If only one person were working here, however, it would be advisable to eliminate the tiny darkroom.

⅛ inch = 1 foot

PORTRAIT AND COMMERCIAL

Left—This studio was built in one of those deep, narrow store spaces often found in suburban shopping centers. Since there is no room for a hallway, it is necessary to walk through the camera room to reach the work rooms. The limited space also made it necessary to combine the film processing and printing operations in an all-purpose darkroom, 8 x 15 feet.

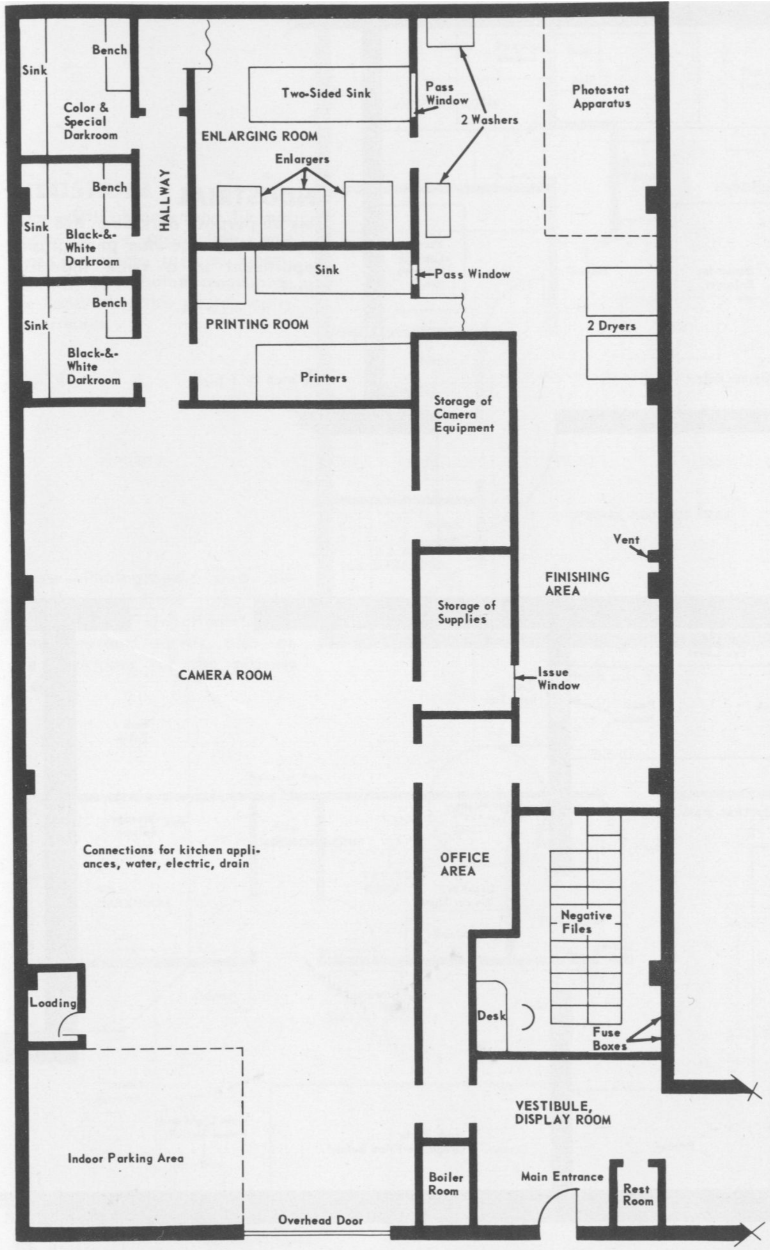


COMMERCIAL

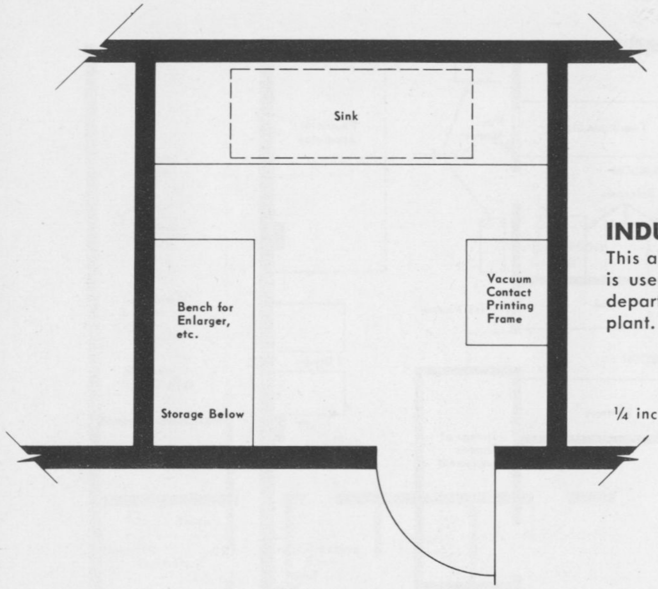
Left—The space devoted to darkrooms in this studio is relatively small. However, a considerable portion of the work consists of motion-picture production, with the processing being done by an outside laboratory.

Right—The work moves along in a U-shaped pattern from camera room through developing and printing areas to finishing area. The two-sided sink in the enlarging room provides maximum working space and allows more convenient handling of extra-large prints by workers on both sides of the sink. A color-processing and special-projects room is included.

1/16 inch = 1 foot



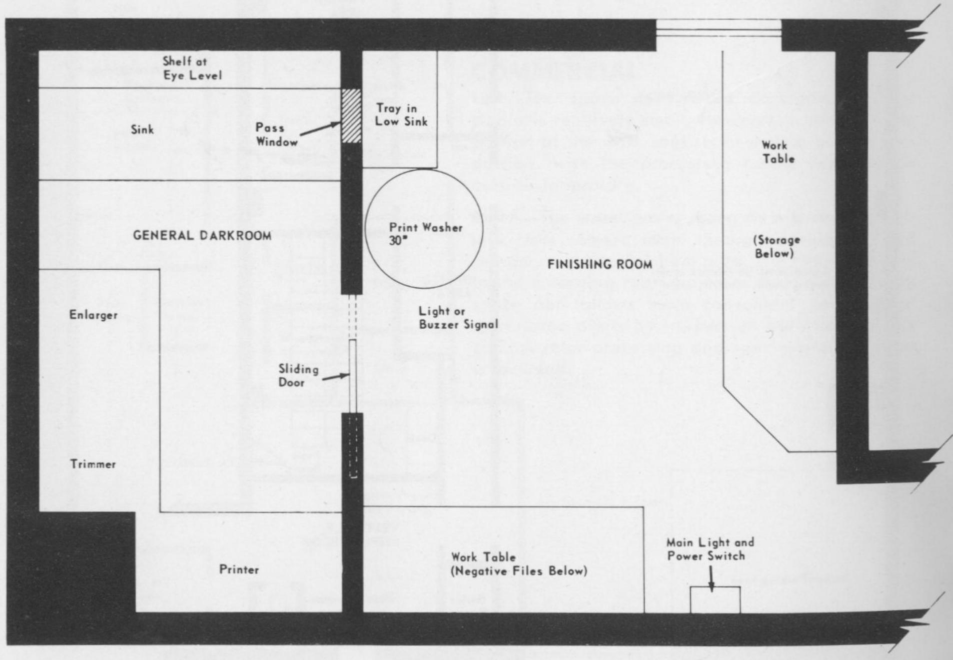
1/16 inch = 1 foot



INDUSTRIAL

This all-purpose darkroom, 8x8 feet, is used by a one-man photography department in a small industrial plant.

¼ inch = 1 foot



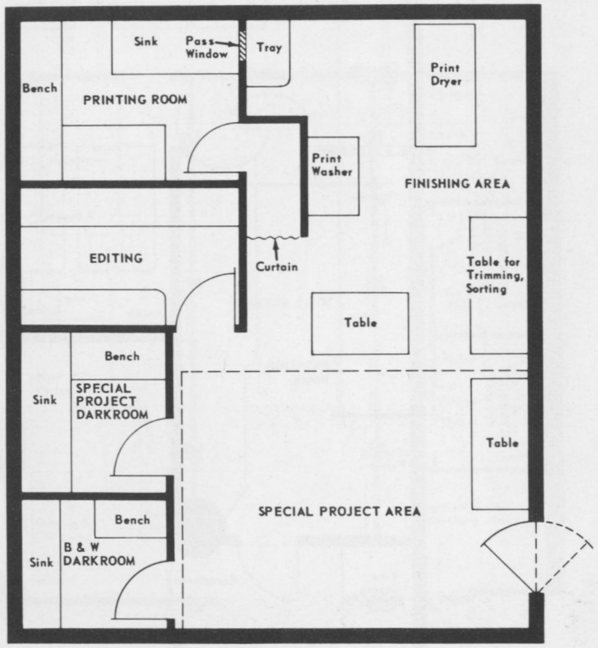
¼ inch = 1 foot

The work of two plant photographers is processed and printed in this all-purpose darkroom with adjoining finishing and storage room. The L-shaped darkroom bench was built around an existing column.

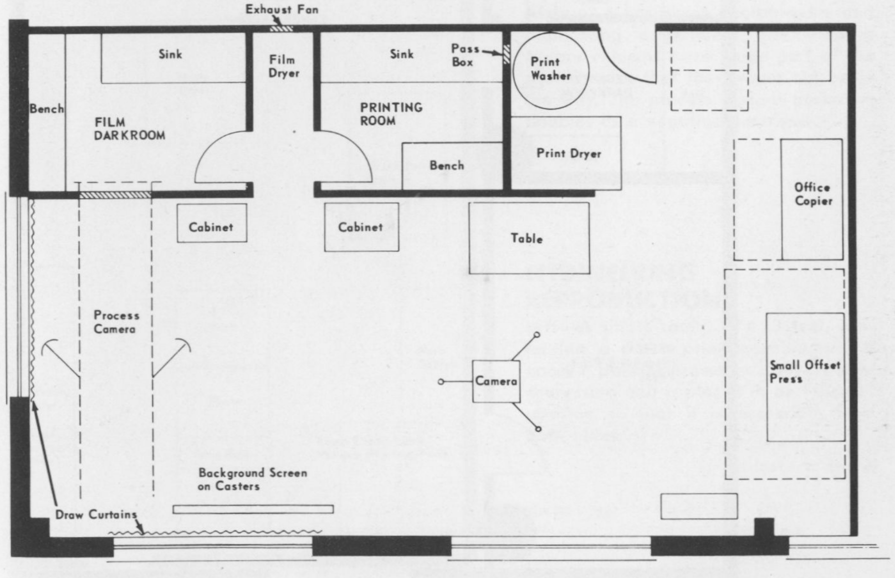
INDUSTRIAL

Right—Still photography, limited motion-picture production, and special projects, such as metallography and photomicrography, are handled in this photography department.

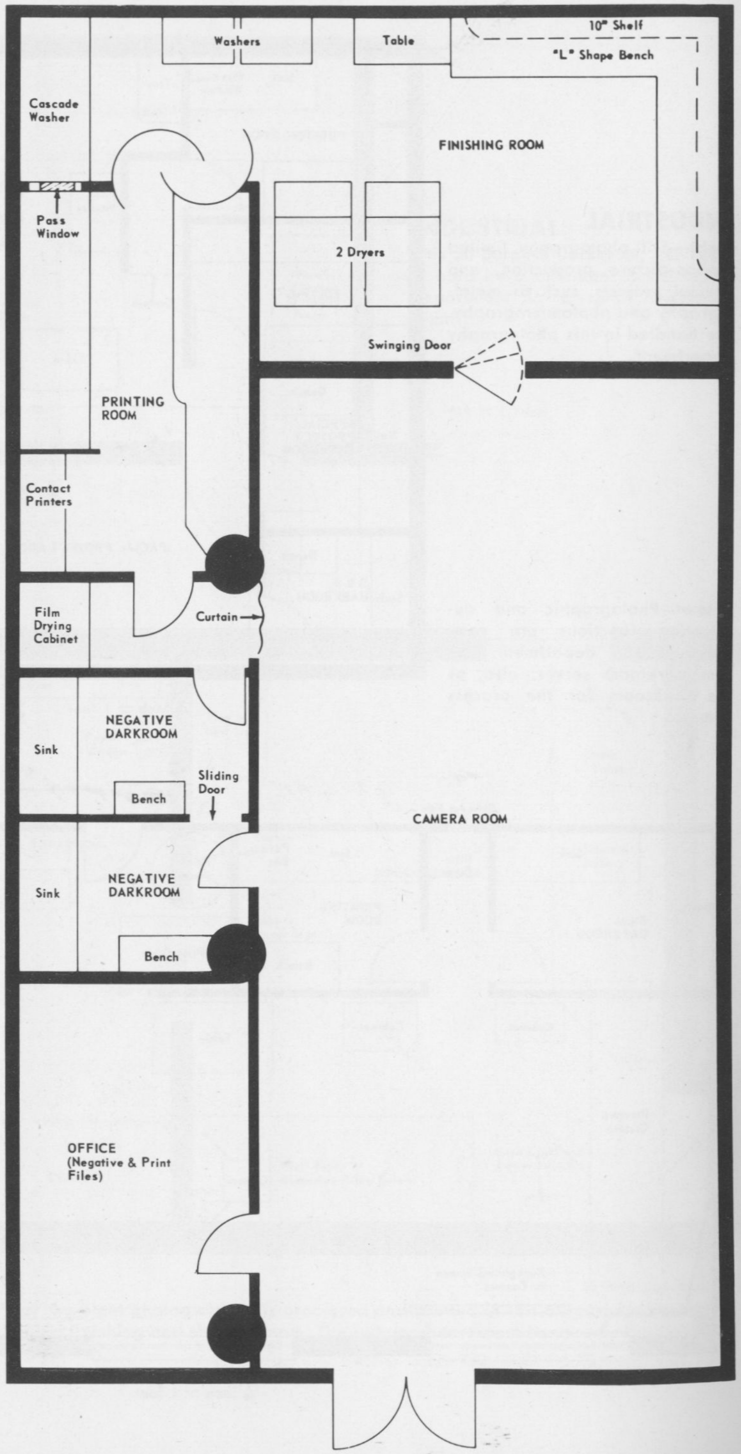
Below—Photographic and duplicating functions are combined in this department. The film darkroom serves, also, as the darkroom for the process camera.



⅛ inch = 1 foot



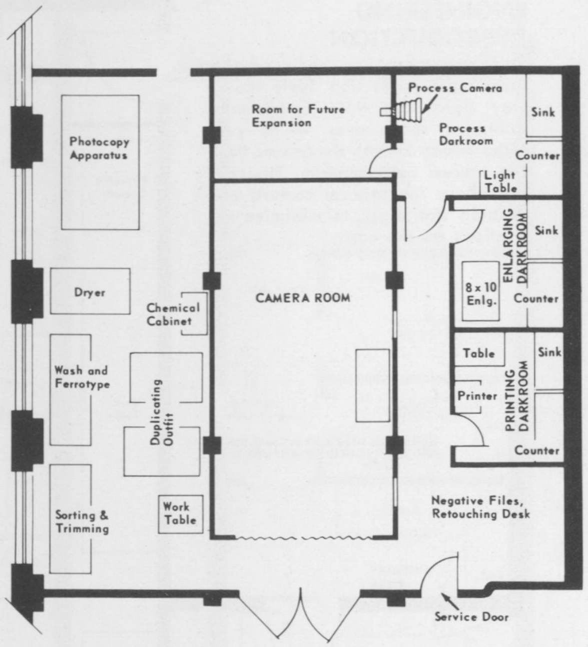
⅛ inch = 1 foot



1/8 inch = 1 foot

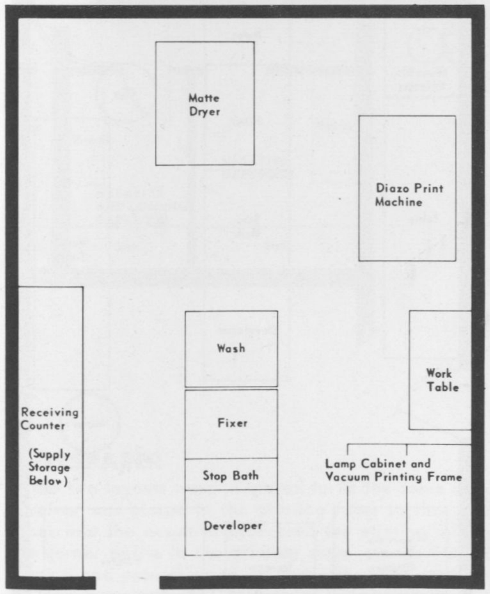
INDUSTRIAL

Opposite page—All the workrooms open directly into the camera room and are readily accessible. The work moves straight along the side and across the end of the area. Darkroom partitions were placed so that the round columns were in room corners where they were out of the way.



1/16 inch = 1 foot

Above—A combined photographic and duplicating department. The existing square columns were made part of the partitions so that they would not be in the way. The process camera darkroom doubles as a negative darkroom.



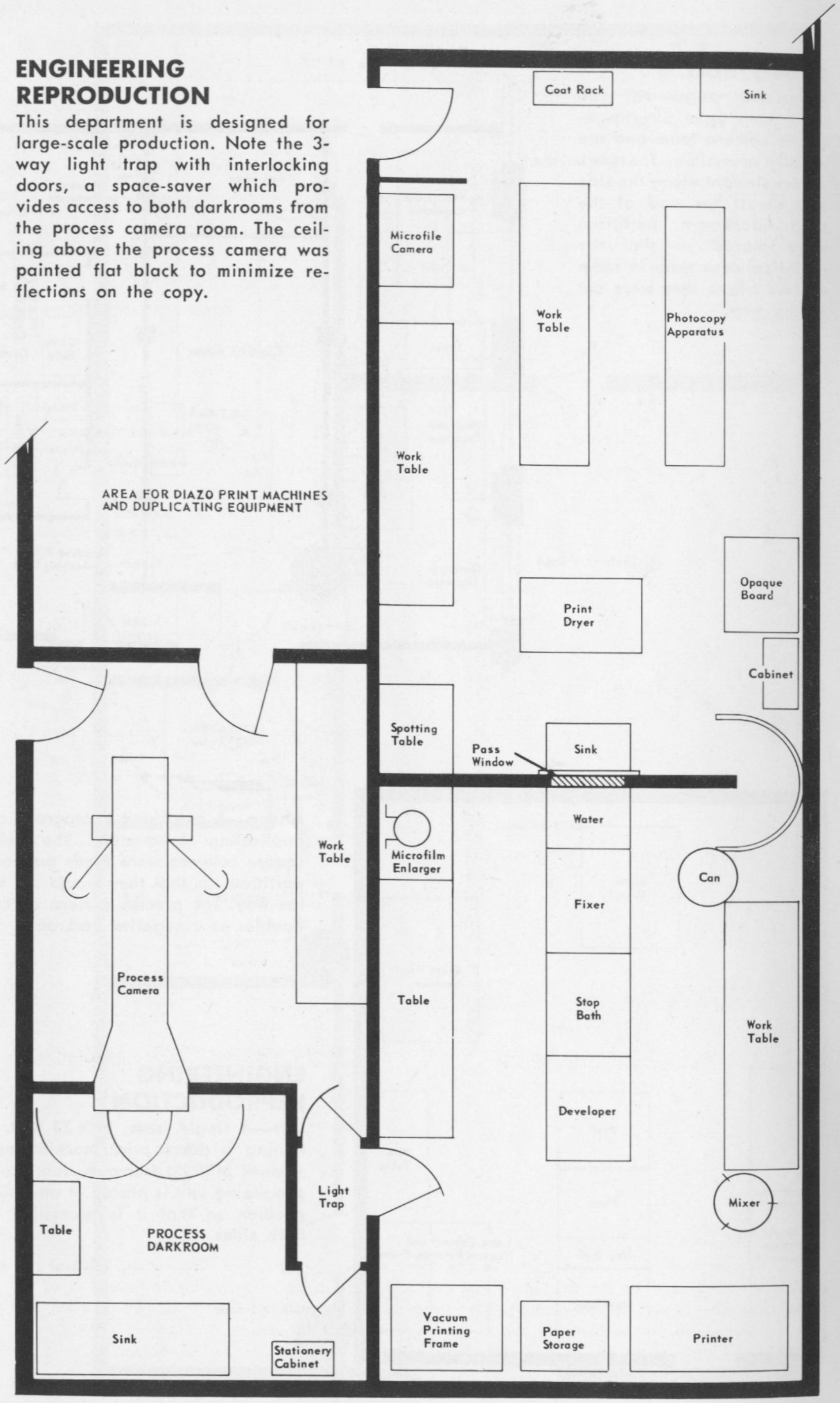
1/8 inch = 1 foot

ENGINEERING REPRODUCTION

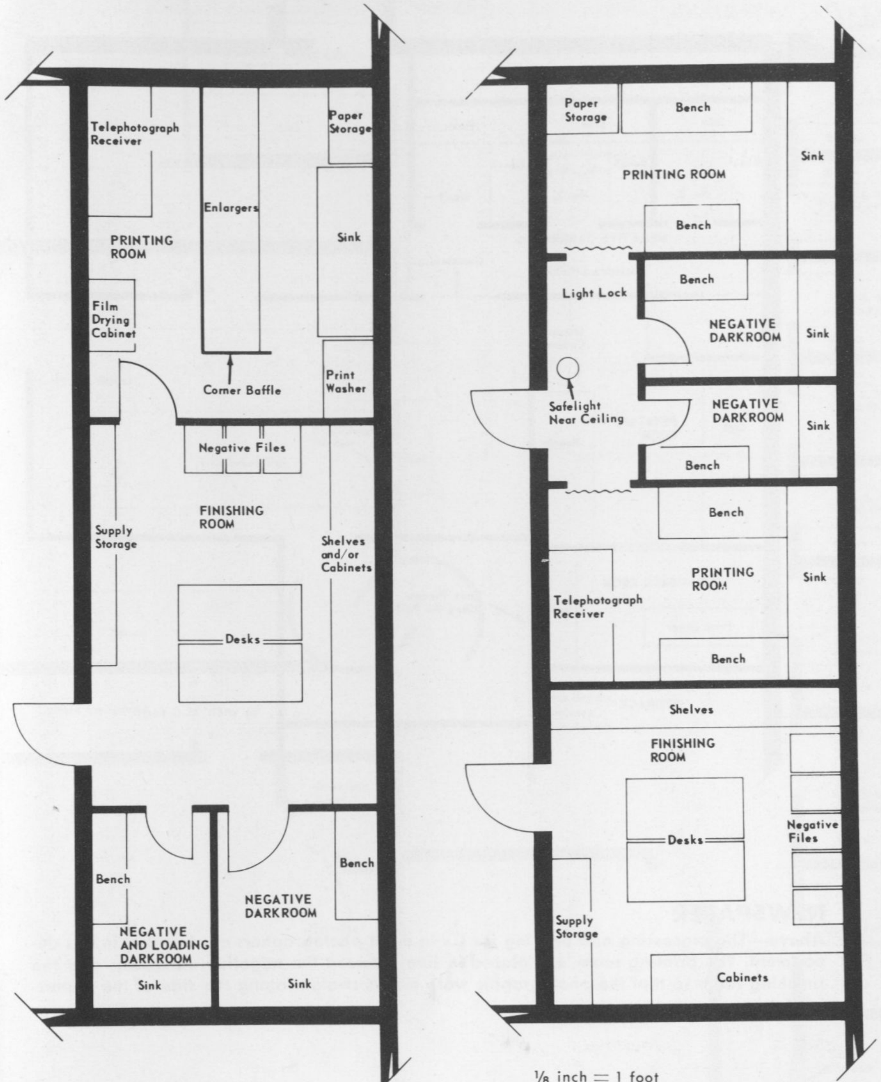
Left—A single room, 19 x 23 feet, containing a diazo print machine and a vacuum printing frame. A stainless-steel processing unit is placed in an "island" position so that it is accessible from both sides.

ENGINEERING REPRODUCTION

This department is designed for large-scale production. Note the 3-way light trap with interlocking doors, a space-saver which provides access to both darkrooms from the process camera room. The ceiling above the process camera was painted flat black to minimize reflections on the copy.



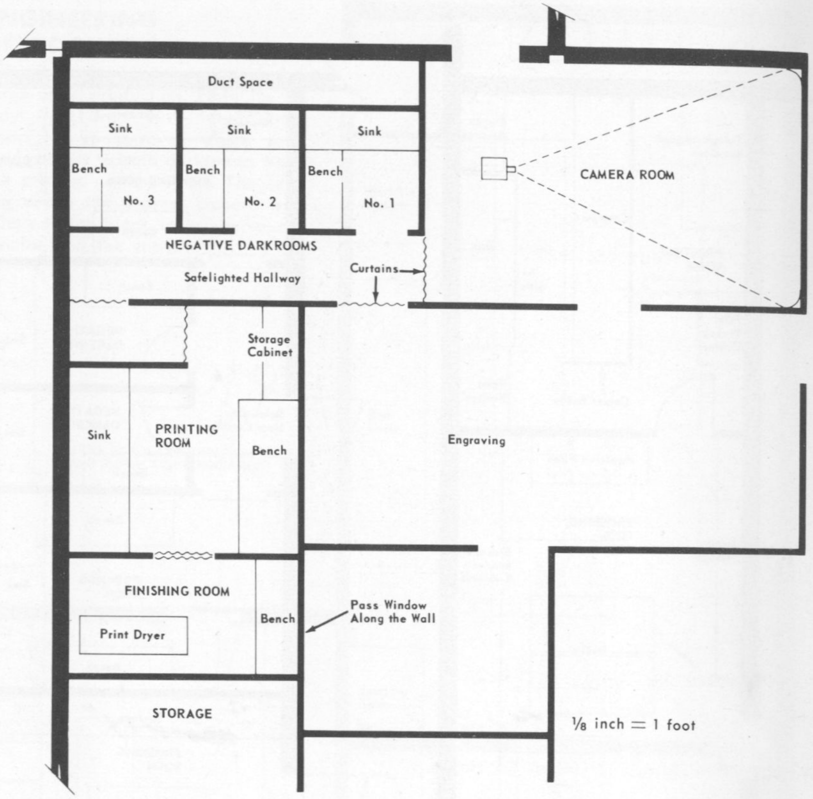
⅛ inch = 1 foot



⅛ inch = 1 foot

NEWSPAPER

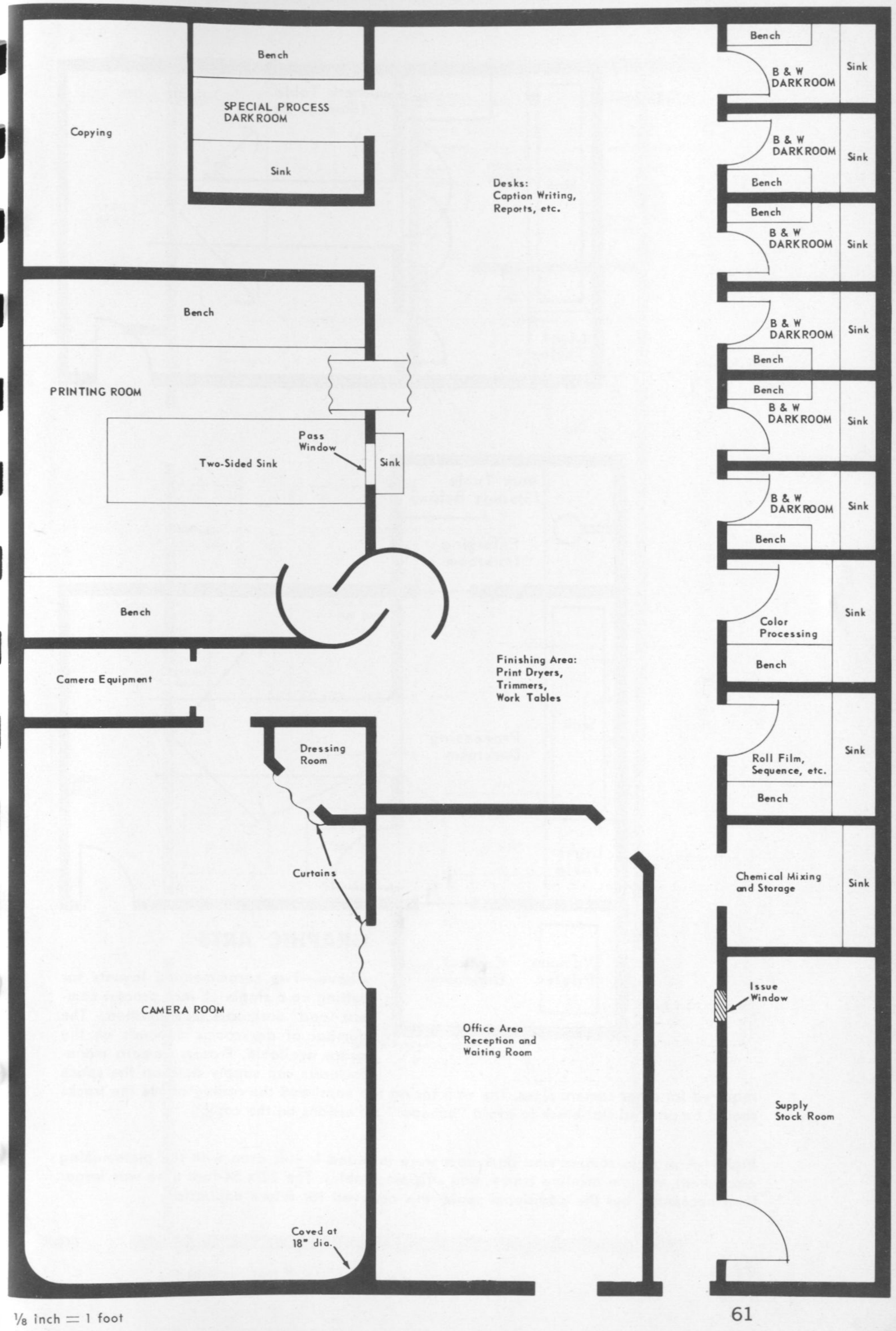
These two layouts were prepared to fit the same space, 12 x 38 feet. The telephotograph receiver was placed in the printing room so that it could be watched by someone at all times and the negative processed for printing without delay. In the layout on the left, the corner baffle in the printing room exends from floor to ceiling and protects the enlarging and processing areas from stray light coming through the opened door.

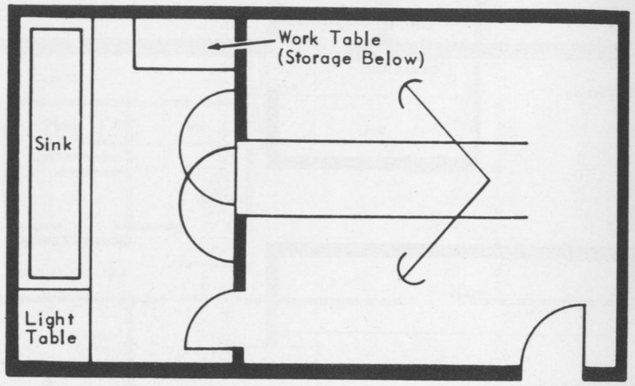


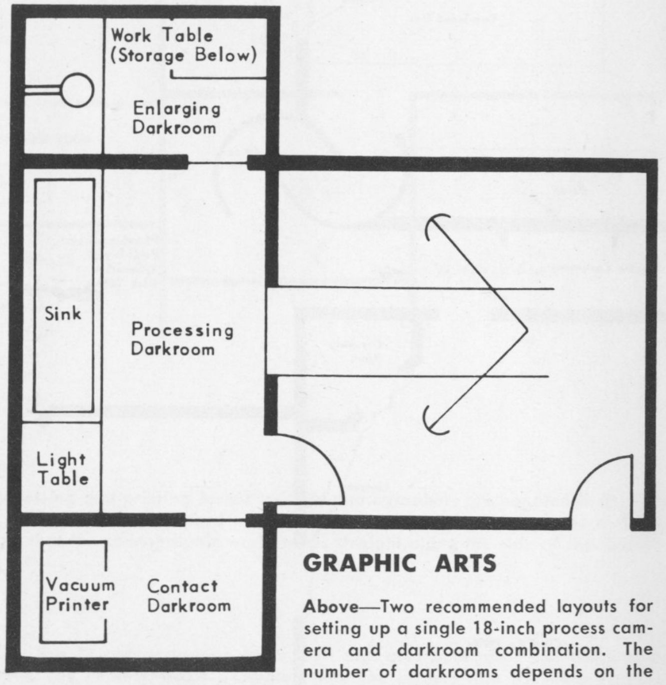
NEWSPAPER

Above—The processing and printing for six to eight photographers are handled in this department. The printing room was placed in line between the negative darkrooms and the finishing room so that the photographic work moves straight along the side of the department.

Right—This paper has 22 photographers on its staff and uses both color and black-and-white photographs. The printing room is located near the center, with its two entrances directly accessible from any film-processing room to provide an uninterrupted flow of traffic during peak rush periods.





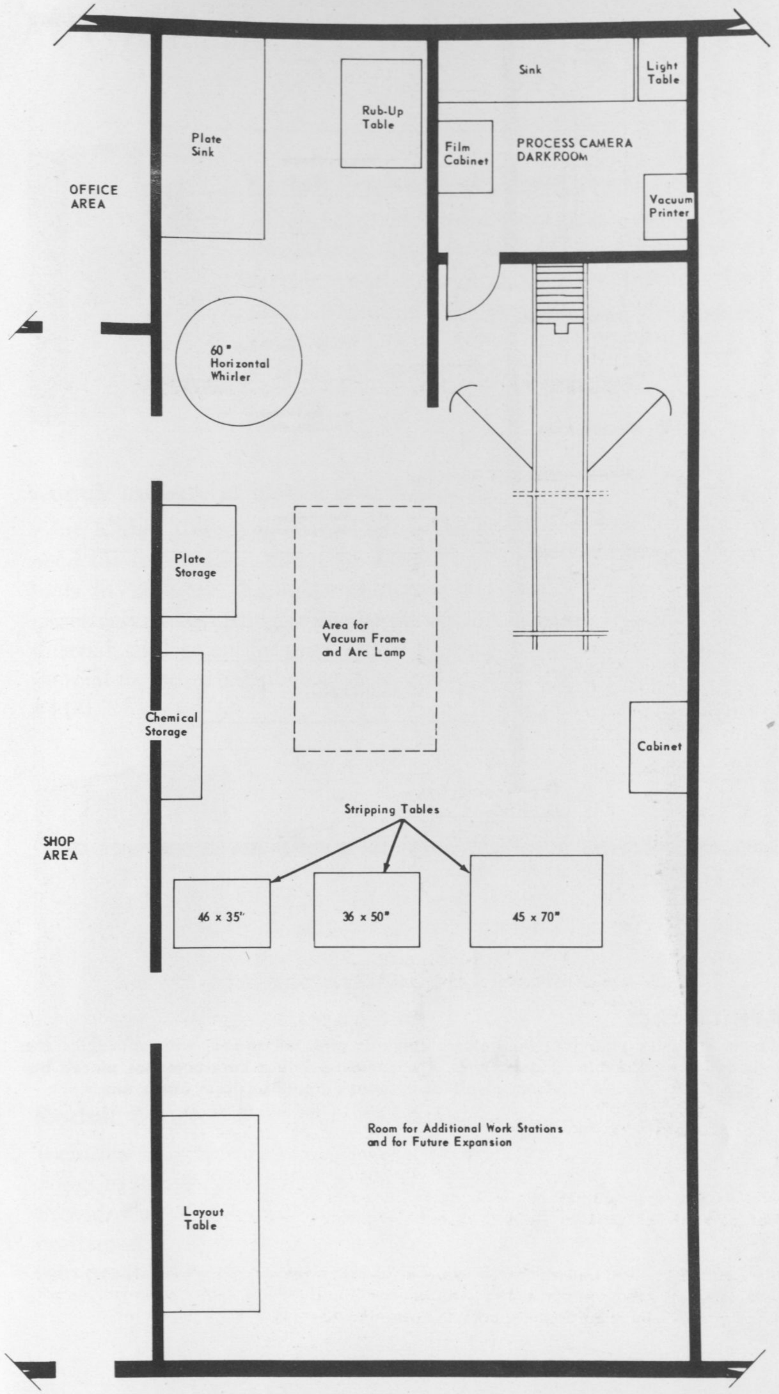


1/8 inch = 1 foot

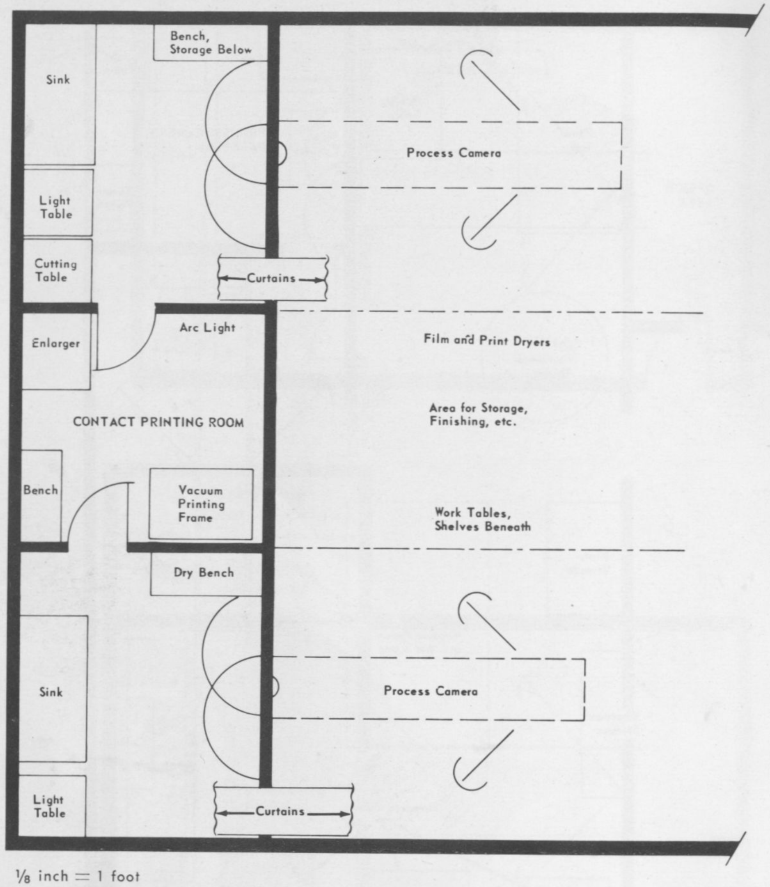
GRAPHIC ARTS

Above—Two recommended layouts for setting up a single 18-inch process camera and darkroom combination. The number of darkrooms depends on the space available. Process camera manufacturers can supply data on the space required for other camera sizes. The wall facing the easel and the ceiling above the tracks should be painted flat black to avoid "hot-spot" reflections on the copy.

Right—A process camera and darkroom were included in this area with the platemaking equipment, vacuum printing frame, and stripping tables. The 22 x 54-foot area was larger than necessary, but the additional space was reserved for future expansion.



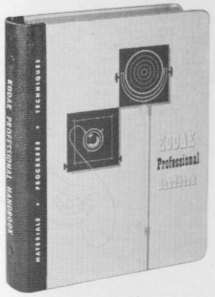
1/8 inch = 1 foot



GRAPHIC ARTS

This layout was designed for two process cameras and darkrooms, with space for the possible addition of a third camera later. The contact-printing darkroom was placed between the process camera darkrooms so that it could be entered from either one.

AUTHORITATIVE REFERENCE BOOKS

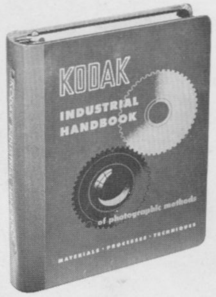


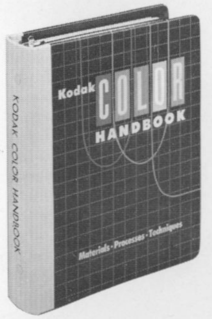
Kodak Professional Handbook:

A manual of the professional's craft. Includes four Kodak Professional Data Books, plus a section with 20 selected sample prints on Kodak photographic paper. These prints include all the emulsions, stocks, and varieties of paper surfaces of interest to professional photographers. 272 pp. Illustrated. $4.00.

Kodak Industrial Handbook (Revised)**:**

Four Kodak Industrial Data Books designed to fill the need for information about photographic techniques as tools in industry. Explains photographic methods for effectively transmitting information within business, industrial, and scientific organizations. Suitable for commercial or industrial photographers. 244 pp. Illustrated. $4.00.





Kodak Color Handbook:

Devoted to color photography of professional caliber. These books provide complete, authoritative information on taking still pictures in color with Kodak materials. Emphasis is on picture taking. 260 pp. Over 100 full-color illustrations. $5.00.

Kodak Graphic Arts Handbook (Revised)**:**

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